Preconception To Year One—Nutrition

Part I
Preconception Nutrition and Nutrition During Pregnancy

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PRECONCEPTION TO YEAR ONE - NUTRITION

PART I - PRECONCEPTION NUTRITION AND NUTRITION DURING PREGNANCY*

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*Part II - INFANT NUTRITION is also available from the Nutrition Division

PURPOSE OF THE MANUAL

This manual was written to provide information on preconception nutrition and nutrition during pregnancy to physicians, nurses, dietitian/nutritionists, childbirth educators and all others who provide health care to parents around the time of conception and during pregnancy. Although the focus is on nutrition, the approach emphasizes the interdependencies of the many contributors to health.

The guidelines presented in the manual arose from a review of the literature by the Nutrition Division staff. Each chapter is prefaced by a summary statement. The main content of each chapter consists of recommendations and the rationale from current literature to support those recommendations.

The manual is endorsed by the Nutrition Committee, British Columbia Medical Association.

The guidelines in this manual are also available in a summary format.

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PRECONCEPTION TO YEAR ONE - NUTRITION MANUAL
PART I
PRECONCEPTION NUTRITION AND NUTRITION DURING PREGNANCY

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CHAPTER I

PRECONCEPTION NUTRITION, PREGNANCY AND LIFESTYLE CHOICES

GUIDELINES AND SUMMARY

Prior to Conception:

Women should select foods of high nutritional quality and should attain an appropriate weight for height.

Women on oral contraceptive agents (OCA) should be counselled about the nutritional effects of OCA. OCA may lower the woman's nutrient levels of B vitamins (B_6, B_{12}, riboflavin, thiamin and folic acid), vitamin C and zinc. Foods rich in these nutrients should be eaten. OCA may increase the body's supply of vitamin A, copper and iron, so supplements of these nutrients should not be taken. Women who are planning to become pregnant should use another method of birth control for at least four months prior to conception to allow the body to return to a normal nutritional state. Use of an intrauterine device (IUD) may lower iron stores if there is excessive blood loss. Attention to iron in the diet as well as monitoring of iron status is recommended.

Around the Time of Conception and During Pregnancy:

It is recommended that women refrain from drinking alcoholic beverages. Safe lower levels of alcohol intake are not known. Alcohol is believed to have specific, independent, teratogenic effects as well as interactive effects with smoking, drugs and poor nutrition. Alcohol affects nutritional status. Chronic alcohol intake can lead to deficiencies of B vitamins and of minerals such as zinc, magnesium, calcium and potassium. An undernourished woman may be at higher risk for the harmful effects of alcohol than the well-nourished woman.

The use of caffeine containing products should be limited. An upper limit of 300 to 400 milligrams per day is suggested. This includes the total *contribution of caffeine from coffee, tea, cola beverages, chocolate and medications.*

Women should not smoke or be exposed to secondhand smoke. If a woman does not stop smoking, she should reduce the number of cigarettes smoked. Attention to optimal diet and weight gain in the smoking woman may decrease to some extent the detrimental effects of smoking.

It is recommended that care be taken in the selection of herbal teas. Rosehip, mint, lemon balm, raspberry and strawberry leaf are generally regarded as safe. Herbal teas to be avoided include pennyroyal, devil's claw root, rue, scotch broom and goldenseal. All medicinal herbs should be avoided around the time of conception and during pregnancy. Any other herb should be used in moderation.

There is an absence of adequate information on the teratogenic or toxic potential of over-the-counter and prescription drugs. For protection of the fetus against any potential harm, it is recommended that, whenever possible, drugs be avoided. The decision to use or to eliminate a drug should be made by an informed woman, her physician and the pharmacist. Drug-nutrient interactions must be considered. If a drug must be used, consultation with a dietitian/nutritionist may be necessary.

It is recommended that individuals consider their exposure to environmental hazards. To reduce any possible hazards related to food, one should use as many fresh, whole foods as possible and limit the fabricated or highly processed alternatives, especially during pregnancy. Fruits and vegetables should be washed thoroughly before they are eaten.

It is recommended that regular exercise be part of one's life prior to pregnancy and that it be continued throughout pregnancy, unless there are contraindications. A woman's level of physical activity should not be drastically increased during pregnancy. Caloric intake must be high enough to meet energy needs for activity in addition to pregnancy needs.

A mother-to-be should have a dental examination prior to pregnancy or early in pregnancy to insure that her own dentition is well maintained and to receive advice and counselling on preventing dental diseases. Thorough brushing and flossing at least once every twenty-four hours is recommended. A reduction in the amount and frequency of intake of sticky carbohydrate is advised.

Severe physical and psychological stress have nutritional implications. Women under stress should receive information and guidance about stress management from a qualified health professional. Nutrition counselling by a dietitian/nutritionist is also recommended. Physical stress (hard physical work or play) imposes an additional demand for calories. Psychological stress may increase calorie needs as well as the need for nutrients such as protein, vitamin C, the B vitamins and calcium. The amounts of nutrients needed to cover the costs of psychological stress are not yet known. Until further information is available, additional food sources of the above nutrients are recommended rather than supplements.

Excessive intake of vitamins and minerals should be avoided. Toxic effects in human infants from excessive intakes of vitamins A, D and C by the mothers have been reported. If supplements are taken, they should not exceed the amounts in the Recommended Nutrient Intake Table (Chapter V), unless the need has been carefully assessed and the person has received nutrition counselling.

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A NEW FOCUS - PRECONCEPTION CARE

It has been estimated that 35 percent of handicap originates in the first eight weeks of pregnancy and is not amenable to modification by prenatal care (1). The importance of the period of embryogenesis or organogenesis is now recognized. Often, these processes occur before a woman knows she is pregnant.

Optimal health of women prior to conception is a new focus in pregnancy education. The health status of the male prior to conception is also believed to be important. For example, there have been reports on the effects of smoking and of drinking alcohol on the quantity and quality of male sperm (2-5).

A review of the literature on the relationship of low birth weight and congenital malformations to wartime and postwar food shortages in Europe has been published by Margaret and Arthur Wynn (6). Data from this review shows that the most serious consequences occurred in infants conceived during the food shortages. For example, deaths from congenital malformations increased by 50 percent for infants conceived prior to and born during the Dutch food shortage, but increased more than 100 percent for infants conceived during the food shortage and born after the food shortage had ended.

Although the incidence of handicap is much lower now than in times of food shortage, handicaps occur too frequently. In 1980, in British Columbia, 2,130 infants (5.33 percent of live births) were born with one or more birth defects such as club foot, cleft palate, pyloric stenosis and septal defects (7).

It was also noted in the studies of food shortages that the malformed babies were not born to the most poorly fed women, who were infertile, but to women whose nutrition was marginal. These women were still fertile but not well enough fed to have healthy babies (8).

The Wynns refer to this area between infertility and fertility as the "penumbra", a chemists' term for shade (8). It describes the level of nutrition and reproductive health adequate to support conception but inadequate to produce a normal healthy infant. Some women even in the prosperous countries fall in the penumbra (9). Women may become infertile or marginally fertile as a result of poor nutrition, anorexia, self-induced weight reduction or excessive exercise.

Nutritional status prior to conception is important not only in itself, but also because poor nutritional status is believed to enhance the detrimental effect of other maternal-fetal hazards such as alcohol and drugs. A French toxicologist has described the relationship between the dose of a toxin and the body's defences using the concept of "metabolic space". He states that "tolerance to any substance is based on the metabolic space concept within which the body will adjust its requirements and defences with much flexibility whether we deal with a nutrient or a toxic substance" (10).

Nutritional deficiencies are believed to reduce the size of metabolic space within which a toxin can be metabolized and so reduce the toxicity threshold. Wynn and Wynn have reviewed animal and human studies which show that the toxic effect of drugs is increased in the presence of undernutrition (11).

In this chapter, lifestyle choices are discussed in relation to nutrition prior to conception and during pregnancy.

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NUTRITIONAL STATUS

Prior to conception, women should select foods of high nutritional quality and should attain an appropriate weight for height.

The current system of nutrition counselling for pregnancy starts too late - after the very critical early stages of development and usually after the baby is well formed. The following concepts for preconception nutrition education are presented so that the nurse, physician or other nutrition counsellor can use them as an aid in counselling (1):

1. Each partner should be in good nutritional status and have good general health to increase the chances of producing a healthy ovum and a healthy sperm.
2. The mother has the responsibility of providing not only the environment for growth of the embryo and fetus but also the resources for delivery and breast-feeding the infant. Her good health prior to conception will enhance her physical and mental status throughout the pregnancy and the postpartum period.
3. The embryo and the placenta need the right nutrients at the right times for optimal development (2). These building materials must come from the mother's bloodstream and in turn from the foods that she eats and from her body stores.
4. Body stores are not just body fat, but also reserves of very important nutrients such as vitamins and minerals. In other words, one cannot depend on fat stores as a source of other nutrients.
5. How do we know nutrition is important? Evidence from historical records indicate that in times of famine, women who managed to become pregnant had an increased risk of producing an abnormal baby. The risk was greatest if the woman was severely undernourished just before she became pregnant or in very early pregnancy. Studies in countries where the diet is deficient in certain vitamins or minerals show that the incidence of

malformations is particularly high. Experiments with animals fed diets deficient in one or more nutrients, are either unable to reproduce, or the offspring are often abnormal to some degree (3). A good diet also has a protective effect against infection and may help to protect to some extent against the harmful effects of substances which may enter the body - drugs, toxins, pollutants, etc. (3).

6. The basis of good nutrition is outlined in food guides such as "Canada's Food Guide" and "The Vegetarian Food Guide", found in Appendix B. These food guides should be thought of as a nutritional base, not as an upper limit. The servings listed are minimum amounts for good health for the average healthy person.
7. Read "Canada's Food Guide" very carefully.
   - Note that two servings (cups) of fluid milk provide necessary vitamin D but that other milk products do not. A supplement of vitamin D is recommended if fluid milk is not consumed. Other nutrients provided by all milk products are calcium, protein, riboflavin, niacin and vitamin A (4). Refer to Appendix C for sources of calcium.
   - Whole grains may take the form of whole grain bread, for example, wheat or rye; whole grain cereals (oatmeal, muesli or granola, shredded wheat); brown rice; whole wheat pasta. Whole grain flour should be substituted at least for part of the white flour in recipes. Whole grains supply greater quantities of nutrients such as vitamin E, B_6, folate and zinc than refined grains (4).
   - Meats, fish and poultry are major sources of protein and also supply iron, B vitamins, vitamin A and fat. When you cook meat or poultry, use the bones to make nutritious and economical broths or vegetable soups. Organ meats and shellfish are excellent sources of minerals. Eggs are an excellent source of protein and may be eaten daily without concern about cholesterol. Peas, beans, lentils, nuts and seeds are also excellent sources of protein (4). The "Vegetarianism and Pregnancy" chapter of this manual contains important information about the use of plant proteins.

- Use fresh and raw fruits and vegetables daily. Choose a dark green and yellow vegetable daily. When preparing vegetables, try to retain as much of the food value as possible. Scrub rather than peel vegetables and leave the skins on potatoes. Use a steamer and lightly cook vegetables. Fruit and vegetables supply vitamins and minerals such as vitamins A and C, thiamin, and folic acid and minerals potassium, iron, copper and zinc (4).

8. Avoid or limit sweets, cakes, sugars, pop, foods which are very high in calories and low in nutrients. If your diet is made up of these "empty calorie" foods, you will be taking less of the wholesome foods. Another concern is that "empty calorie" foods are considered "thieves of nutrients". When a food is metabolized in the body, vitamins and minerals are needed for the many chemical reactions which occur. When a food contains its own vitamins and minerals as it should, these can be used as required. An "empty calorie" food has to draw upon the body's stores so that it can be metabolized properly; that is, it may "steal" vitamins and minerals from your reserves.
9. Choose food sources of nutrients which are especially important in human reproduction such as folic acid, pyridoxine, zinc, calcium and iron. (See Appendix C). For information on nutrient functions, refer to the chapter on "Energy and Nutrients in Pregnancy".
10. It is important to attain an appropriate weight for height prior to conception. A woman who is underweight at conception increases the infant's risk of being premature, having a low birth weight and a low Apgar score (5). A woman who is overweight at conception increases her own risk of developing complications associated with hypertensive-cardiovascular disease and diabetes mellitus (6). If dieting prior to conception, allow at least four months after the weight loss program is over before attempting to conceive. This will allow the body's nutrient stores to return to normal. For further information, refer to the chapter entitled "Weight Changes in Pregnancy".

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ALCOHOL

Until safe lower levels of alcohol intake are established, it is recommended that women refrain from drinking alcoholic beverages around the time of conception and throughout pregnancy. Alcohol affects nutritional status. Chronic alcohol intake can lead to deficiencies of B vitamins and minerals. A woman who is undernourished may be at a higher risk for the harmful effects of alcohol than the well nourished woman.

Effects of Alcohol Consumption

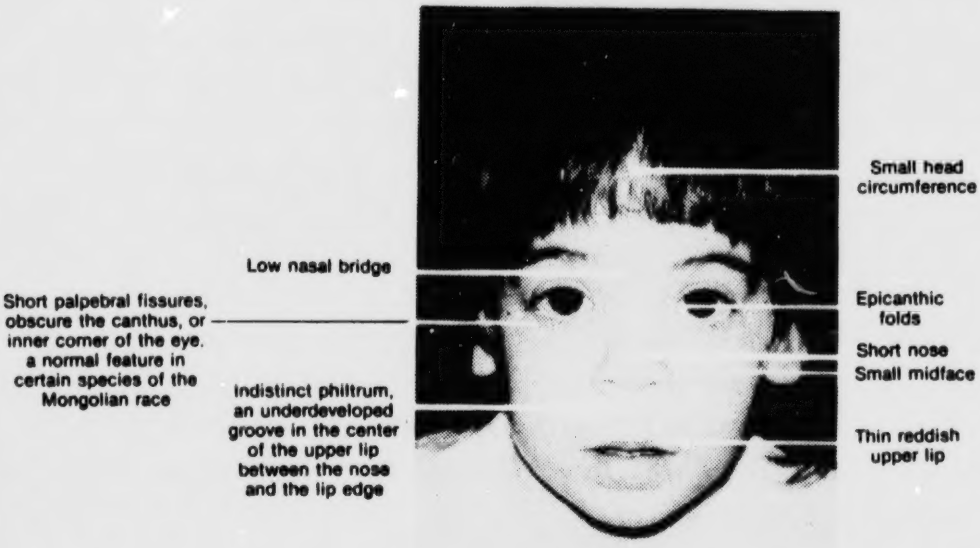
A 1980 report from Statistics Canada stated that the total consumption of alcohol increased 37% between 1966 and 1978 and that B.C. is the province with the greatest percentage (73.2%) of "current drinkers" (one or more drinks per month) (1). The 1982 Canada Health survey showed that the average daily consumption level for female drinkers in B.C. is .9 drinks; for male drinkers in B.C. 1.9 drinks (2).

Many women reduce their alcohol intake during pregnancy because the taste of alcohol does not appeal as much (3), or as a result of increased awareness of the effects of alcohol on the fetus (4). On the other hand, it has been estimated (U.S. data) that 1 in 900 children suffer Fetal Alcohol Syndrome (FAS) from mother's intakes of four or more drinks a day (5). Perhaps even more children suffer unrecognized fetal alcohol effects from lower intakes of alcohol (6). There is some evidence from animal and human studies that FAS-like defects may occur in infants whose fathers are heavy drinkers (7).

The effects of FAS include mental retardation, hyperactivity, prenatal and postnatal growth impairment and defects in cranio-facial development (see Figure 1). These effects appear to be permanent (5).

Figure 1

Characteristic Anatomical Defects that are Signs of the Fetal Alcohol Syndrome


Small head circumference
Low nasal bridge
Short palpebral fissures, obscure the canthus, or inner corner of the eye, a normal feature in certain species of the Mongolian race
Epicanthic folds
Short nose
Small midface
Indistinct philtrum, an underdeveloped groove in the center of the upper lip between the nose and the lip edge
Thin reddish upper lip

SOURCE: "NUTRITION TODAY", SEPTEMBER/OCTOBER, 1980

If these facial characteristics occur, a differential diagnosis is important to establish whether they are related to FAS or to other syndromes (8).

FAS is not easy to diagnose and it was not until the late sixties in France and the early seventies in the U.S. that the syndrome was described in the medical literature. The variability of effects of alcohol probably results from differences in amounts of intake at different times during pregnancy, the genetic susceptibility of the individual, the pattern of consumption (binge drinking may be particularly harmful) and whether or not food is taken with the alcoholic beverage to slow absorption (5). FAS is the most severe end of the spectrum of alcohol effects. Along the continuum are persons with every sub-combination of effects varying in severity (8).

There is evidence that the effects of alcohol are dose-related, and that lower levels of intake of the "social drinker" may be related to lower infant birth weights (6,9,10). Alcohol intake prior to pregnancy has also been reported to have a negative effect on infant birth weight. Wright et al., recently reported that women who drank more than 10 drinks per week prior to pregnancy had an increased risk of low birth weight in the child (9).

More research is needed to establish whether there is a lower level of alcohol intake prior to conception and during pregnancy where no effects would occur. At present, abstinence is the only known "no risk" level of intake (8).

The father's drinking habits cannot be ignored in assessing alcohol's effects on the developing fetus (8). More studies are needed to clarify these effects, but it has been found that alcoholics are often impotent or sterile. They may also have a decreased production of sperm, and their sperm may contain abnormal cells (11). As a result, there is a possibility of producing defective offspring (8).

Mode of Action

The mechanisms by which alcohol exerts its effects are not yet fully understood (5). Alcohol is believed to have specific, independent teratogenic effects as well as interactive effects with poor nutrition, smoking and drugs (5).

The following modes of action, hypothesized from animal studies have been summarized by Rosett and Abel (7,12). During the first trimester, alcohol may alter cell membranes and the embryonic organization of tissue. Throughout the pregnancy, direct effects of alcohol on the metabolism of carbohydrates, lipids and proteins may retard cell growth and division. Alcohol may interfere with active transport of amino acids across the placenta. In the third trimester, the time of most rapid brain development, high blood alcohol concentrations may impair central nervous system growth and therefore future intellectual and behavioural development.

The detrimental effects of alcohol on nutritional status have been well documented. Appetite may be reduced resulting in decreased caloric intake and the absorption, metabolism and excretion of nutrients are affected. Deficiencies of the B complex vitamins, especially folate and pyridoxine, and of minerals such as zinc, magnesium, calcium and potassium, are associated with chronic alcohol intake (13).

In addition to the effect of alcohol related nutritional deficiencies, it is believed that a deficiency state itself may lower the body's defences and reduce the threshold of toxicity. The undernourished woman, pregnant or not pregnant, may be at higher risk for alcohol effects than the well-nourished woman (7).

It is believed that a reduction of alcohol consumption at any stage of pregnancy could modify some of the adverse biochemical and physiologic effects on the maternal-placental-fetal system (14). Rosett has outlined helpful guidelines for counselling pregnant women who drink (14). The advantages of optimal nutrition should be emphasized when counselling women who drink.

One drink may be defined as follows (14):

- 340 mL (12 oz.) beer
- 142 mL (5 oz.) wine
- 43 mL (1.5 oz.) of 80-proof liquor.

Common definitions from the literature:

- Heavy drinking = more than 4 drinks per day
- Moderate drinking = 2-4 drinks per day
- Binge drinking = more than 5 drinks at a time.

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CAFFEINE

It is recommended that caffeine containing products be limited around the time of conception and during pregnancy. An upper limit of 300 to 400 milligrams per day is suggested. This includes the total contribution from coffee, tea, cola beverages, chocolate and medications.

Caffeine is found in coffee, ordinary tea, chocolate, cola beverages, some foods and many drugs.

The annual consumption of coffee per person in the United States, between 1946 and 1976, decreased 44 percent (1), yet coffee is still considered the most widely used mood-modifying drug in this society (2). The annual consumption of soft drinks per person in the U.S. has increased 157 per cent between 1960 and 1976 (1). Table I lists the caffeine content of some selected foods, beverages and medications (3-9).

Effects of Caffeine Intake

Scientific studies of the effects of caffeine on human reproduction are few, but there have been many animal studies. Groisser, Rosso and Winick have summarized the results of animal studies which show that ingestion of large quantities of coffee may cause severe congenital anomalies in the offspring. These anomalies include cleft palate, delayed skeletal ossification and ectrodactylia; an increased percentage of resorptions; and a moderate degree of fetal growth retardation (10).

The above authors have studied the effects of prenatal exposure to both caffeinated and decaffeinated coffee on the offspring of pregnant rats. Newborns from both groups suffered effects such as lower organ weights and behavioral abnormalities but fewer effects were observed in the group whose mothers drank decaffeinated coffee. The authors suggest that the

TABLE 1

APPROXIMATE CAFFEINE CONTENT OF SOME BEVERAGES, FOODS AND MEDICATIONS

BEVERAGES	CAFFEINE mg/200 mL (approximately 7 oz.)
Soft Drinks	
Regular Colas	23-42
Diet Colas	21-35
Caffeine-free Colas	.08
Coffee	
Instant	82-94
Percolated	130-166
Dripolated	182-204
Flavoured Coffees	58-122
Decaffeinated Coffee	6-10
Bagged Tea	
Black, 5 minute brew	56-72
Black, 1 minute brew	30-48
Loose Tea	
Black, 5 minute brew	58
Green, 5 minute brew	50
Green, Japan, 5 minute brew	30
Iced Tea	12-26

CHOCOLATE	CAFFEINE mg
Chocolate bar, 30 g (1 oz.)	5-20
Chocolate, baking, 30 g (1 oz.)	45
Cocoa/Hot Chocolate, 200 mL (7 oz.)	8-14
Chocolate Syrup, 30 mL (2 T.)	10-17

MEDICATIONS	CAFFEINE mg/tablet
Non-Prescription	
Aspirin Compounds, Bromo Seltzer	32
Cope, Midol	32
Excedrin, Anacin	32-60
Dristan, Sinarest	30
No Doz	100
Vivarin	200
Pramaline, Dexatrim	140-200
Coricidan	32
Prescription	
APC's (Aspirin, Phenacetin & Caffeine)	32
Darvon Compound	32
Migral	50

effects may be due to components other than caffeine or to the small amount of caffeine remaining in the coffee. The authors caution the reader that the quantity of coffee consumed by the rats per unit of body mass is considerably higher than even very high intakes in humans. They also point out that there are many metabolic differences between the rat and the human and that meaningful comparisons are difficult; for example, the fetal human brain could be either more sensitive or less sensitive than the fetal rat brain to the active compounds in coffee (10).

A much publicized recent study reported no adverse effects of coffee consumption on human pregnancy (11). The study has been criticized for its definition of heavy coffee consumption (four cups or more), for not obtaining information on whether the coffee was decaffeinated, and for not including other sources of caffeine to obtain a more accurate appraisal of the total amount consumed (12). It has been found that the prime source of caffeine for young adult women is not from only coffee, but is from an accumulation from over-the-counter stimulants, analgesics, appetite suppressants, colas, tea, cocoa and coffee (12).

Weathersbee et al. found in a retrospective study (13), that caffeine consumption of 600 milligrams or more was associated with spontaneous abortion in first trimester, stillbirths and premature births. If the father's caffeine intake was 600 milligrams or more, while the mother's was 400 milligrams or less, similar reproductive difficulties were identified, but they were fewer than in the group where the mother's intake of caffeine was 600 milligrams or more. The authors state that the intake of alcohol and tobacco in this group was believed to be low enough to minimize any multifactorial action of alcohol, smoking and caffeine.

These data do not establish a cause-and-effect relationship between a high level of caffeine consumption and a high risk of fetal loss, but they do suggest the need for large, well controlled studies of the effect of caffeine on human reproduction. In the meantime there is enough information on the effects of caffeine to warrant caution.

Mode of Action

The exact mode of action of caffeine has not been determined. Several theories have recently been summarized by Worthington-Roberts(14).

1. Caffeine, a methylated xanthine, has a chemical structure similar to a purine, one of the constituents of DNA. Animal studies have demonstrated caffeine's ability to alter genes and break chromosomes, perhaps by being inserted into the nucleic acid structure or inhibiting DNA polymerase activity. It has been suggested that caffeine acts as a mutagen by virtue of its chemical structure.
2. Caffeine has been shown to increase levels of cyclic AMP (adenosine monophosphate). Cyclic AMP plays a regulatory role in cellular metabolism and controls the rate of many cellular reactions. This increase may influence fetal development since AMP levels are usually low during gestation.
3. Caffeine ingestion increases circulating levels of catecholamines which through their vasoconstrictive properties, may decrease both uterine and placental blood flow patterns.

Caffeine passes easily across the human placental barrier and enters fetal circulation. Enzyme activity, needed for oxidizing the methylated xanthines, is not attained until 3 to 4 1/2 months of age in the newborn (15). Data on the human fetus is not available, but in the human newborn the elimination of caffeine takes 20 to 30 times longer than in the adult (16).

Pregnant women, particularly in the last trimester, require 18 to 20 hours to metabolize half the caffeine ingested, while the half-life of caffeine for the non-pregnant women is 3-7 hours (17).

In an adult, caffeine in low doses (200 milligrams or less) can decrease fatigue and increase mental alertness. Moderate doses can produce slightly increased rates of breathing, heartbeat, basal metabolism, urination and secretion of gastric juices. Some people are more sensitive to the effects of caffeine and may experience nausea, anxiety, insomnia, headache, dizziness and excessive urination. High doses (exceeding 700 milligrams) can produce sensory disturbances, muscle spasms and rapid heartbeat (2). Caffeine is a physically addicting drug and withdrawal symptoms can include irritability, increased nervousness and shakiness, inability to concentrate and headaches (2).

Use During Pregnancy

It has been observed that coffee consumption often decreases during pregnancy due to nausea, loss of appetite, indigestion and dislike of coffee's taste (17). An unproven hypothesis is that, in part, this may be nature's attempt to protect the fetus from the effects of caffeine (14).

The Federal Drug Administration in the U.S. has advised pregnant women either to eliminate completely or to limit their intake of products containing caffeine (18). Based on our review of the literature, a daily upper limit of 300 to 400 milligrams seems appropriate at the present time.

Some guidelines related to caffeine consumption in pregnancy follow.

1. Individual responses to caffeine should be considered. Those who are most sensitive to the effects of caffeine may wish to avoid it completely.

2. Caffeine-free, grain based beverages are available. Ingredients may include roasted malt, barley, figs, chicory or carob powder. Excessive consumption may have a laxative effect (19).

3. Alternative drinks such as those made with fruit juice are often satisfying and nourishing.

4. Most herbal teas are caffeine free. For information on those safe to use see the "Herbal Teas" section of this manual.

5. If coffee or tea are used, brewing or steeping for a shorter time decreases caffeine content.

6. Using decaffeinated coffee will reduce caffeine intake, however, further information is needed on its effects.

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SMOKING

Women should not smoke or be exposed to second hand smoke around the time of conception and during pregnancy. If a woman does not stop smoking, she should reduce the number of cigarettes smoked. Attention to optimal diet and adequate weight gain in the smoking woman may decrease to some extent the detrimental effects of smoking.

According to 1977 data for those aged 15 and over, approximately 27 percent of B.C. females and 30 percent of B.C. males, are regular smokers (persons who usually smoke daily) (1).

Effects of Smoking

It is well established that cigarette smoking results in fetal growth retardation. Results of a recent well controlled study showed that infants of smoking mothers weighed an average of 184 grams less than infants of non-smoking mothers (2).

There have been reports that smoking is also associated with reduced birth length and smaller head circumference and with an increased incidence of perinatal mortality, prematurity and placental pathology (3,4,5).

There is some inconsistent evidence that smoking is related to an increased incidence of spontaneous abortion and to congenital abnormalities (4). Long term disabilities in areas such as reading, spelling, mathematical skills, I.Q. scores and school behaviour have been observed in children of smoking mothers (6,7,8). An increased incidence of lower respiratory tract disease has also been reported (9).

The relationship between smoking and fertility needs further investigation but there is some evidence that cigarette smoking decreases fertility in women and that men who smoke have increased abnormal sperm morphology and decreased sperm counts (10).

The placentas of women who have never smoked but live with a smoking person or work in a smoke-filled environment, that is, women who are exposed to second hand smoke, have shown changes similar to those in placentas of smoking women (11).

Mode of Action

The mechanisms by which smoking exerts its effect on human reproduction are not yet fully understood. It has been postulated that nicotine stimulates the fetal autonomic nervous system resulting in the release of catecholamines. Catecholamine release results in vasoconstriction of the utero-placental vascular bed, with a reduction in utero-placental blood flow (4). The fetus may be deprived of oxygen and nutrients.

Another possible interference with normal growth and development of the fetus is an excess carboxyhemoglobin level in the smoking pregnant woman (carbon monoxide replaces oxygen in the hemoglobin molecule). Fetal tissue hypoxia may result (4).

There are hundreds of chemicals in cigarette smoke, any of which may act as reproductive toxins. The mechanisms by which these toxins act either independently or synergistically may be highly complex (12).

It is important to note Butler's findings in a large scale British study, that a change in maternal smoking habits during pregnancy (stopping by the end of the fourth month) put the infant into a lower risk group (13). The detrimental effects of smoking may also be decreased by a reduction in the number of cigarettes smoked. The lower the number of cigarettes smoked the lower the incidence of low birth weight and neonatal mortality (12).

Smoking and Nutrition

It is not clear to what extent nutrition is related to the growth impairment in infants of smokers. Metcoff has reported that smoking appears to significantly affect levels of some nutrients and cell bioactivities in pregnant women (14). Picone and Higgins reported that in spite of higher caloric and nutrient intakes of smokers, the effect of smoking on birth weights remained (15, 16). Picone hypothesizes that the efficiency of energy utilization may be decreased by smoking and outlines possible mechanisms for this effect (15).

Luke observed birth weights, lengths and head circumferences of infants of women placed in four weight groups: poor, low-normal, high-normal and excessive. As weight gain increased, the detrimental effects of smoking decreased (4). Luke hypothesized that a higher maternal pregravid weight or a higher weight gain may promote more efficient adaptation to the hypoxia resulting from smoking, or may act as compensatory mechanisms themselves. The higher maternal pregravid weight may represent a greater nutrient reserve that can be mobilized; the larger weight gain may represent a richer circulating pool of nutrients available to the placental-fetal unit (4).

Popoz et al. also reported a protective effect of higher weight gain but cautioned that a direct effect of smoking on fetal growth remains, even with higher weight gains (17).

Cigarette smoking prior to conception may lower the woman's levels of vitamin C (18), carotene and folic acid (19). It has been suggested that findings of decreased serum folate and carotene in smokers may explain the higher incidence of cleft lip and palate in their infants (20, 21).

Marijuana Use

To date, very little human research exists on the effects of marijuana use on pregnancy. Pharmacological studies have demonstrated that marijuana and its derivatives cross the placenta and have a potential for exerting toxicological and teratological effects directly on the fetus (22). Methodological problems must be worked out in future studies before the effects of marijuana are determined (22).

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HERBAL TEAS

It is recommended that care be taken in the selection of herbal teas. Rosehip, mint, lemon balm, raspberry and strawberry leaf are generally regarded as safe. Herbal teas to be avoided include pennyroyal, devil's claw root, rue, scotch broom and goldenseal. All medicinal herbs should be avoided around the time of conception and during pregnancy. Any herb should be used in moderation.

Historically, herbal preparations have been used for medicinal purposes and as refreshing, or in some cases, nourishing teas (1,2). For centuries, women have used herbs during pregnancy, childbirth and the postnatal period. There are, however, herbs which should not be used around the time of conception or during pregnancy because they are possible abortifacients or have oxytoxic properties. Among those to be avoided are pennyroyal, devil's claw root, rue, scotch broom and goldenseal (3,4). All medicinal teas, for example sassafras, uva-ursi and slipperly elm should be avoided (3,4). Active ingredients in herbs can cross the placenta and affect the fetus.

As the popularity of herbal teas increases, some allergic reactions and harmful effects are being reported. For example, camomile, goldenrod, marigold and yarrow may cause allergic reactions in persons sensitive to ragweed, asters, chrysanthemums and related plants (15). Care must be taken to accurately identify plants used for tea bases, for example, one elderly couple in the U.S. picked what they thought was comfrey but was actually foxglove (the source of the highly toxic heart drug, digitalis). They made some tea with the foxglove and were poisoned (5).

If care is taken in their selection, moderate consumption of some herbal teas by healthy individuals is no cause for concern. Rosehip, mint, lemon balm, raspberry and strawberry leaf are generally regarded as safe at any time (7). Women with nausea may find ginger tea soothing and it is considered to be safe for pregnant women (7). A small amount of an herb tea being safe, does not mean a large amount is equally safe. With herbs, as with nutrients, in some cases large amounts may be harmful.

The following guidelines are offered for those who would like further information on herbs.

1. At present there are not many experienced herbalists in B.C.. Books on herbs are available (8-11), including an inexpensive paperback, "The Herb Book", by John Lust (1). Herbs with abortifacient properties are listed in this book.
2. There are some herbalists and botanists who offer plant identification walks. One should never drink tea made from unidentified plants just as one should never eat unidentified mushrooms or berries.

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OVER-THE-COUNTER AND PRESCRIPTION DRUGS

There is a lack of information on the teratogenic or toxic potential of drugs. For protection of the fetus against any potential harm, it is recommended that drugs be avoided whenever possible around the time of conception and during pregnancy. The decision to use or to eliminate a drug should be made by an informed woman, her physician and the pharmacist. Drug-nutrient interactions should be considered. If a drug must be used, consultation with a dietitian/nutritionist may be necessary.

The use of drugs around the time of conception and during pregnancy is potentially harmful to both the woman and the developing fetus (1). There is a lack of information on the teratogenicity or toxicity of many drugs which makes informed medical and parental decision-making impossible (2).

Drug effects include congenital malformations; effects which are less visible but serious, such as growth retardation or impaired immune system; or long term effects which may not appear until the next generation (3).

Despite the potential harmfulness of drugs, use is common. In a recent study (2), 304 randomly selected postpartum inpatients reported taking 93 different drug products during pregnancy (alcohol, tobacco and vitamins were excluded). Of the total number of drugs, 32 percent were prescribed, 68 percent were over-the-counter, off-the-shelf purchases. The authors reported that over-the-counter drugs are often not thought of as "real drugs". For 51 of the 93 drugs taken, the authors found published reports in the literature of adverse effects on offspring (79% of the studies were animal studies).

To avoid any risk associated with taking drugs during pregnancy, the first step is to encourage good health to discourage the use of any unnecessary drug. The second step is for the woman and her physician to explore alternatives to drugs; for example, rest, fluids and the use of a vaporizer may be superior to the use of cold remedies, for which there is limited information on safety during pregnancy (4).

There is evidence from animal and human studies that drug effects are more pronounced in the poorly nourished than in the well nourished (5). Poor nutritional status is an important contraindication to drug use. If a drug is used, it is important that the woman be as informed as possible about the dosage, ingredients, side effects and any food-drug interactions associated with the drug.

Information on food-drug interrelations may be found in the "Diet Manual" published by the British Columbia Dietetic Association available from all health units and hospitals in B.C. (6). If a drug is used, consultation with a dietitian/nutritionist may be necessary.

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ENVIRONMENTAL HAZARDS

It is recommended that individuals consider their exposure to environmental hazards. To reduce any possible hazards related to food, one should use as many fresh, whole foods as possible and limit the fabricated or highly processed alternatives, especially during pregnancy. Fruits and vegetables should be washed thoroughly before they are eaten.

The belief that the human embryo is shielded from external causes of maldevelopment has been overturned in this century. The discoveries that ionizing radiation, the rubella virus, and the chemicals aminopterin, thalidomide and DES (diethylstilbestrol) are teratogenic occurred in 1920, 1941, 1952, 1962 and 1972 respectively (1). Many other substances are suspected of being teratogenic or of having other toxic effects, but research reports are conflicting (1).

Practically all chemicals, if administered in sufficiently high doses, will harm an embryo or fetus. Further efforts must be made to define the limits of risk of environmental hazards. Duration of exposure is an important consideration. A drug may be taken for a week or a month; workers may be exposed to agents in the workplace for years. The time of exposure to a toxic agent is believed to be critical. Exposure in the first three weeks may result in spontaneous abortion; from the third to the eighth week, the period of organogenesis, the fetus is susceptible to structural deformity; and in later stages, growth retardation and functional disturbances are the most common consequences of exposure (2).

Roughly 100,000 chemicals are in relatively common use and approximately 1,000 new compounds are being introduced each year. The toxicity, mutagenicity, carcinogenicity and teratogenicity of only a fraction of these substances has been investigated (3).

There is insufficient evidence at present to define the magnitude of reproductive risk associated with environmental hazards but there are good grounds for concern. Substances in the environment which may be harmful to embryo, fetus or infant have been classified by Longo (3) as macroenvironmental pollutants or hazards (those over which the individual can exert little control) and microenvironmental hazards (those over which the individual can exert control).

Longo's examples of macroenvironmental pollutants include: heavy metals (mercury, lead, cadmium), dioxins, polychlorinated and polybrominated biphenyls (PCB's and PBB's), organochlorine pesticides, polycyclic aromatic hydrocarbons, and radiation. Examples of microenvironmental pollutants include tobacco smoke, alcohol, some drugs and some food additives (3).

Some tips to use in counselling those who wish to reduce their exposure to environmental hazards follow.

1. Become informed about possible environmental hazards and avoid or control them as much as possible.
2. If employees are exposed to chemicals in the workplace:
   (a) clothes and shoes worn at work should not be taken home
   (b) eating facilities should be away from the work area
   (c) hands and face should be thoroughly washed before eating
   (d) the workplace should be well ventilated.

   A questionnaire format for assembling data about the employed pregnant woman and her partner has been developed by the American College of Obstetricians and Gynecologists in a report entitled "Guidelines on Pregnancy and Work" (5). This report is available from the B.C. Ministry of Health library.
3. Wash fruits and vegetables thoroughly before they are eaten.
4. Controversy continues about the safety of nitrates or nitrites, artificial colors, artificial sweeteners and MSG (monosodium glutamate) (6). Some food additives are undergoing further testing, others have been declared safe on the basis of current scientific knowledge (7,8,9). Until more data becomes available,

one should use as many fresh, whole foods as possible and limit the fabricated or highly processed alternatives, especially during pregnancy.

5. To avoid ingestion of polychlorinated biphenyls (PCB's), one should (10):

   (a) avoid eating fresh water fish from contaminated lakes and rivers as these fish can concentrate PCB's

   (b) decrease fat consumption by eating lean meats, removing the skin from chicken before cooking, and using lower fat dairy products.

6. There is some evidence that an adequate diet may have a protective effect and perhaps reduce the risks of exposure to environmental hazards (11). For example, in studies of children, who are exposed to lead, the children who are well nourished have lower blood lead levels than children who are poorly nourished (12, 13).

7. For additional information on environmental hazards, see references 14 and 15. These are available from the Ministry of Health library. Refer also to the sections on smoking, alcohol and drugs in this manual.

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PHYSICAL FITNESS

It is recommended that regular exercise be part of one's life prior to pregnancy and that it be continued throughout pregnancy, unless there are contraindications. A woman's level of physical activity should not be drastically increased during pregnancy. Caloric intake must be high enough to meet the activity needs in addition to pregnancy needs. There are some exercises which should be avoided during pregnancy. Physical activity programs should be gradual, satisfying and appropriate for the individual.

Physical fitness is a positive and dynamic quality, an essential ingredient of optimal health. Fitness enhances one's ability to meet the demands of the environment: to persevere, to withstand stress, to resist fatigue and to possess the energy for an abundant life. Women in the childbearing years are becoming increasingly active in a wide variety of physical activity programs.

There are few published studies on the influence of maternal fitness on pregnancy, labor and fetal development. Anecdotal evidence suggests that women who are fit have more energy, less fatigue and a reduced incidence of backaches, varicose veins, constipation and excessive weight gain. They may also experience a more comfortable labor and delivery and a quicker return to a normal figure (1,2). Moderate exercise increases the efficiency of the circulatory system which transports nourishment to the fetus. Improved abdominal strength may help one accommodate some of the physiological and anatomical changes which occur in pregnancy. Exercises for developing good posture, for improving the muscle tone of the pelvic floor, and for learning deep relaxation can all be very helpful (3). There is some concern that strenuous exercise, especially for the unfit or moderately fit person may decrease uterine blood flow. Moderation is advised and recommendations must be individualized (4).

Some contraindications to enrolling in a physical activity program may be poor obstetrical history, high blood pressure, heart disease, renal disease, Addison's disease and other hormonal disorders, bleeding in pregnancy, toxemia and in some cases diabetes (3). It is important to tailor perinatal physical activity to individual needs. A team approach of fitness instructors and health professionals may be appropriate in providing guidance and avoiding unnecessary complications (3).

Some basic guidelines on exercise and nutrition are listed below (1,2,5). The information is presented in a way that health professionals can use it in counselling.

1. Ideally, exercise as part of a woman's daily life begins prior to pregnancy. A pattern of physical activity should be maintained as long as it is comfortable. The frequency, intensity or duration of exercise should not be increased during pregnancy. The demands on the body will increase naturally as a result of the physiological changes which occur.

2. With pregnancy there is a loosening of the joints and ligaments. Activities which place stress on the joints should be approached with caution. The stamina activity, swimming, is highly recommended because the buoyancy of the water eases the stress. Walking, cycling and other activities with no sudden starts and stops, twists or turns are preferred to activities such as racquetball, skipping, basketball, or volleyball.

3. Strengthening exercises are recommended for developing good posture and alleviating back problems and other aches and pains associated with pregnancy. Strengthening exercises will make the stamina activities more enjoyable by reducing the likelihood of injury. For specific exercises, refer to "Perinatal Fitness" (5).

4. During pregnancy, it is important to maintain the strength of the pelvic floor and sphincter muscles. This may help reduce the strain from the pressure of the heavier uterus, improve bladder control, prevent hemorrhoids and form a firm elastic canal for childbirth. Refer to "Perinatal Fitness" for specific exercises (5).

5. Suppleness exercises should be done before and after all stamina and strength activities. These gentle "bends and stretches" will ease muscle tension thus preparing the body for labor and delivery and will further reduce chances of injury during the stamina activities. Refer to "Perinatal Fitness" for specific exercises (5).

6. A firm brassiere with non-elastic straps will prevent discomfort from bouncing breasts and thus reduce strain on supporting muscles and prevent breakdown of fibrous tissue. A molded cup instead of one with seams will be gentler on tender nipples. Women may also be encouraged to support their breasts with their hands during stamina activities.

7. The sensible approach to exercise recommends regular physical activities from each of the three fitness components:

Stamina activities	3-5 sessions per week, 10-15 minutes per session. These should increase the rate of breathing but be comfortable enough so one can carry on a conversation - "talking pace".
Strength activities	3-5 sessions per week, 10-15 minutes per session, no straining, no holding of breath.

Suppleness activities	1-2 sessions per day s-t-r-e-t-c-h-i-n-g and holding to a count of 6. No bouncing!

A balance between stamina, strength and flexibility is needed. If any of these exercise components is emphasized over the others, optimal benefits will not occur and an increased risk of soreness and injury will result. A variety of activities may be chosen from within the three groups to increase enjoyment.

8. Practicing relaxation techniques will assist with the relief of stress, tension and tiredness that often accompany pregnancy.

9. It is imperative that caloric intake cover the energy costs of both pregnancy and physical activity. Table II provides a guide to calculate calories required for various activities per kilogram of ideal pregnant body weight (6).

10. Physical activity also increases nutrient requirements. Additional thiamin, riboflavin and niacin are needed to metabolize the extra calories consumed (7). Although rarely necessary, some physically active people have a high protein intake. If protein intake is increased, foods high in B_6 should be selected (7). See Appendix C for food sources of these B vitamins.

11. Fluid lost during activity must be replaced. If not, the effect is cumulative and a woman will begin to experience dehydration fatigue earlier in her work-outs. Little is known about fluid needs of the pregnant exercising woman. The following information applies to the non-pregnant woman. Dehydration fatigue occurs when as little as 2 to 3% of total body weight as fluid is lost while exercising (8). This is only approximately 2 1/2 pounds for a 130 pound woman. Fluid loss would not be a concern if thirst were an accurate indicator of fluid

TABLE II

•HOW MANY CALORIES DO YOU BURN?

CALORIES USED PER MINUTE ACCORDING TO YOUR WEIGHT

	WEIGHT						
ACTIVITY lbs.	100	120	150	170	200	220	250
kgs.	45	55	68	77	91	100	114
Badminton	4.3	5.2	6.5	7.4	8.7	9.6	10.9
Bicycling, 5.5 mph	3.1	3.8	4.7	5.3	6.3	6.9	7.9
Bicycling, 10 mph	5.4	6.5	8.1	9.2	10.8	11.9	13.6
Calisthenics	3.3	3.9	4.9	5.6	6.6	7.2	8.2
Canoeing, 4 mph	4.6	5.6	7.0	7.9	9.3	10.2	11.6
Golf	3.6	4.3	5.4	6.1	7.2	7.9	9.0
Handball	6.3	7.6	9.5	10.7	12.7	13.9	15.8
Mountain climbing	6.6	8.0	10.0	11.3	13.3	14.6	16.6
Jogging, 11-min. mile	6.1	7.3	9.1	10.4	12.2	13.4	15.3
Running, 8-min. mile	9.4	11.3	14.1	16.0	18.8	20.7	23.5
Running, 5-min mile	13.1	15.7	19.7	22.3	26.3	28.9	32.8
Racquetball	6.3	7.6	9.5	10.7	12.7	13.9	15.8
Skating, moderate	3.6	4.3	5.4	6.1	7.2	7.9	9.0
Skiing, downhill	6.3	7.6	9.5	10.7	12.7	13.9	15.8
Skiing, cross-country	7.2	8.7	10.8	12.3	14.5	15.9	18.0
Squash	6.8	8.1	10.2	11.5	13.6	14.9	17.0
Swimming, breaststroke	4.8	5.7	7.2	8.1	9.6	10.5	12.0
Swimming, crawl	5.8	6.9	8.7	9.8	11.6	12.7	14.5
Table tennis	2.7	3.2	4.0	4.6	5.4	5.9	6.8
Tennis	4.5	5.4	6.8	7.7	9.1	10.0	11.4
Volleyball, moderate	2.3	2.7	3.4	3.9	4.6	5.0	5.7
Walking, 3 mph	2.7	3.2	4.0	4.6	5.4	5.9	6.8
Walking, 4 mph	3.9	4.6	5.8	6.6	7.8	8.5	9.7

Note: To calculate the approximate number of calories you burn at a given activity, find the figure in the table closest to your weight and multiply by the number of minutes of continuous activity. These numbers were developed under standardized conditions at the Human Performance Research Centre at Brigham Young University in Provo, Utah. Many factors, such as air temperature, clothing, and the vigor with which you participate, can result in an increase or decrease in the number of calories you burn.

needs, but it is not (8). The following is a guide to how much fluid is required (8):

HOW MUCH FLUID TO REPLACE?

$$A = B - C$$

A = weight lost in water to be replaced before further activity
B = weight before activity
C = weight after activity

For every pound lost, drink 16 ounces of fluid. Water and fruit juice are recommended.

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12. Attention to appetite is important. The primary fuel for aerobic exercise is fat, particularly after 15-20 minutes. The resultant increase in free fatty acids depresses appetite. In addition, there is some evidence that ketone production may be harmful to the developing fetal brain (9). These phenomena, compounded by the fact that most people prefer to exercise on an empty stomach, emphasizes the need to plan meals and exercise sessions in a way that assures adequate food intake.

13. The length of time a woman can safely spend in a hot tub or sauna around the time of conception or during pregnancy has been estimated to be 10 minutes at 41.1 degrees C or 15 minutes at 39.0 degrees C. Longer exposure increases the risk of their core temperature reaching a level that might have an adverse effect on the developing embryo or fetus (10). Individuals who are especially sensitive to heat should consider avoiding hot tubs or saunas.

14. Exercising with family and friends or to music can add to the joy of fitness.

15. Some exercises to avoid during pregnancy are: double leg raises in a sitting or lying position; exercises requiring difficult balancing positions; standing toe touches; and shoulder stands. Other exercises to avoid are listed in the booklet "Fitness and Pregnancy - A Leader's Manual" (for address, see below).

Sources for further information on fitness and pregnancy are:

"Fitness and Pregnancy and "Fitness and Pregnancy" - A Leader's Manual

FREE from:
Regional Office
Fitness and Amateur Sport
408 - 325 Granville Street
Vancouver, B.C.
V6C 1S5

"Perinatal Fitness"

FREE from: Health Units

PURCHASED from:
Queen's Printer
506 Government Street
Victoria, B.C.
V8V 2L7

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DENTAL HEALTH

A mother-to-be should have a dental examination prior to pregnancy or early in pregnancy to ensure that her own dentition is well maintained and to receive advice and counselling on preventing dental diseases. Thorough brushing and flossing at least once every twenty-four hours is recommended. A reduction in the amount and frequency of intake of sticky carbohydrate is advised.

The following concepts are important in counselling women about dental health and pregnancy.

1. Dental caries and gingivitis (red, swollen, bleeding gums) are plaque related diseases. Dental plaque, a colourless sticky film, consists of bacteria, food debris and saliva. Acids produced by bacterial plaque acting on fermentable carbohydrates, especially sucrose, may result in dental decay; toxins from plaque bacteria produce irritants that may create gingivitis.

   The hormonal changes of pregnancy may lead to a greater susceptibility to gingivitis if dental plaque is left on the teeth. Thorough brushing and flossing once every 24 hours will prevent this condition (1).

   To lower the risk of caries, reduction in the amount and in the frequency of intake of sticky carbohydrates is prudent (2,3). Cookies, candies, white sugar, brown sugar, honey, jams, jellies, syrups, soft drinks and icings are examples of foodstuffs that should be limited, especially between meals.

2. The College of Dental Surgeons of British Columbia has stated that dental radiography is not contraindicated in pregnancy

provided that there is clear indication of the need for x-rays and provided that a lead apron is used (4). The most critical period for fetal injury from radiation would be in the early stages when pregnancy is unrecognized (4), which demands care and responsibility of both dentists and women in the child-bearing years.

3. The development of fetal dentition is related to both genetic and environmental factors. Tooth development begins in utero by the second month, with calcification of teeth occurring by the fourth month. Nutritional deficiencies during the developmental phases of tooth formation may lead to irreversible changes of tissues, particularly enamel and dentin (2,5). The chemical composition, morphology, time of eruption, and the maturation of the tooth can be affected by severe nutritional deficiencies. Calcium, phosphorus, vitamin D, fluoride and protein seem to be of particular importance (6).

   Unfavorable nutritional environments in many animal studies indicate that protein-caloric deficient diets during tooth formation may result in greater susceptibility to dental caries (7).

4. No valid reason exists at present for fluoride supplementation during pregnancy (4,8). Where water supplies are deficient in fluoride, the College of Dental Surgeons recommends supplementation from birth to age fourteen (4). An adequate supply of fluoride during tooth formation can exert a positive influence on subsequent caries susceptibility (7). (Please check with the local health unit for further information.)

5. Tetracycline, a broad spectrum antiobiotic, is contraindicated in pregnancy. It crosses the placenta and may lead to intrinsic staining of the teeth (9).

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STRESS

It is recommended that the nutritional implications of physical and psychological stress be considered. It is also recommended that pregnant women under stress receive information and guidance about stress management from a qualified health professional and that they also be counselled by a dietitian/nutritionist.

Effects of Stress on Nutritional Needs

The main nutritional consideration related to physical stress is that the caloric intake match the pregnant woman's increased energy output (1). The 1983 "Recommended Nutrient Intakes for Canadians" (2) estimates an energy need of 4.5 kilocalories per minute for women of average weight (59 kilograms) involved in the following activities: painting, plastering, modern farming, scrubbing floors, cleaning windows, polishing furniture, gardening. The estimate for lighter domestic or occupational activities such as cooking, ironing, typing, laboratory work, is 2.5 kilocalories per minute. This represents an increase in calorie need of over 50% for hard physical work. It is necessary when judging caloric adequacy to assess appropriate weight for height (prior to pregnancy) and appropriate gain for date (during pregnancy).

Psychological stress during pregnancy has been given attention in the literature only recently (3). The effect of maternal stress on the development of the human fetus is not known. Animal studies show that severe maternal stress may have effects such as fewer conceptions, more spontaneous abortions and lower birth weight offspring (4,5).

The relationships between psychological stress, nutritional status and pregnancy represent a new area of research. Picone recently found that pregnant women do not use energy as efficiently if they are under psychological stress, and do not gain as much weight as their non-stressed counterparts, in spite of similar caloric intakes (6). The mechanisms of this effect are not known but are hypothesized to be related to the increased secretion of hormones stimulated by stress. These hormones (corticoids, catecholamines, growth hormone and prolactin) impair insulin release; stimulate glycogenolysis, lipolysis and gluconeogenesis; increase metabolic rate (6).

This theory of inefficient energy use and lower weight gain may explain the reports that low birth weight is one of the complications resulting from maternal anxiety or life stress (7). Studies of nutrient needs of pregnant women under stress have not yet been done but there are studies of the effects of stress on others. During stress there may be an increased need for nutrients such as protein, vitamin C, B vitamins and calcium. Emotional stresses such as fear, anxiety and anger increase the secretion of epinephrine which, in turn, results in nitrogen loss (8). Vitamin C is used during stress for the release of adrenal hormones (9). B vitamins are involved in metabolism of the extra energy (calories) required. There is lowered absorption and increased excretion of calcium under conditions of stress (8). The amounts of nutrients needed to cover the costs of stress are not yet known. Until further information is available, additional food sources of the nutrients which may be affected by stress are recommended (see Appendix C). The increased calorie and protein levels used at the Montreal Diet Dispensary for "serious emotional upset" may be found in Appendix A.

Information on stress management is available through health units in B.C. One excellent series of modules on stress management, designed for use under the guidance of a physician or community health nurse, psychologist or social worker is available from Western Center Health Group, Suite 445, 717 Denman Street, Vancouver, B.C. V6G 2L6 (10).

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CONTRACEPTION

Women on oral contraceptive agents (OCA) should be counselled about the nutritional effects of OCA. Women who are planning to become pregnant should use another method of birth control for at least four months prior to conception to allow the body to return to a normal nutritional state.

Despite widespread use, knowledge of the interaction between oral contraceptive agents (OCA) and nutrition is limited (1). The studies which do exist have been done on women with access to reasonably healthful diets; there is a paucity of information of the effect of the pill on the less well nourished (1).

OCA may lower the woman's nutrient levels of B vitamins (B_6, B_{12}, riboflavin, thiamin and folic acid), vitamin C and zinc (2,3). Food sources of these nutrients are listed in Appendix C. In some cases, supplements of nutrients such as folic acid or B_6 may be warranted in order to maintain optimal nutritional status. Supplements should only be prescribed after appropriate consultation, evaluation and guidance by a dietitian/nutritionist (3). OCA may increase the body's supply of iron, copper and Vitamin A, so supplements of these nutrients should not be taken (2).

Impaired glucose tolerance has been reported in OCA users (4). Although the reason for this is not fully understood, it is recommended that OCA users reduce their intake of refined carbohydrates, sugars and sweets (2).

OCA use should be discontinued and another method of birth control used for at least four months prior to conception to allow the body to return to a normal nutritional state (2).

The use of an IUD may lower iron stores if there is blood loss (2). Attention to iron in the diet as well as monitoring of iron stores is recommended. Leaflets providing additional information on contraception and nutrition are available from health units throughout B.C. or from the Nutrition Division, British Columbia Ministry of Health.

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EXCESSIVE VITAMIN AND MINERAL INTAKE

Excessive intakes of vitamins and minerals around the time of conception or during pregnancy are hazardous and should be avoided. Supplement amounts should not exceed the 1983 Recommended Nutrient Intake levels unless the need has been carefully assessed and the person has received nutrition counselling.

A survey in seven western U.S. states revealed that between 8-16% of the adult respondents were consuming potentially toxic levels of vitamins A,C and E (1). A proportion of these users may be pregnant while still on excessive intakes.

Worthington-Roberts has summarized the following concerns about excessive vitamin and mineral intake (2).

1. High doses of vitamin A intake in animals has produced cleft palate, abnormalities of the urinary tract and malformations in other organs of the fetus. Malformations in human fetuses have also been associated with high maternal blood levels and fetal liver concentrations of vitamin A.

2. Excessive doses of vitamin D can result in fetal hypercalcemia. Abnormal skull development from excessive vitamin D has been reported in both animal and human newborns.

3. Megadoses (an amount at least ten times greater than the RNI) of water-soluble vitamins are not toxic since the fetus can excrete unneeded amounts, but high doses given to the mother may have other undesirable consequences. For example, if large quantities of vitamins B or C are available to compete with amino acids for transport carriers to cross the placenta, the results could be impaired or defective growth.

4. Two cases of infantile scurvy have been reported when mothers have taken megadoses of vitamin C during pregnancy. It is possible that consumption of excessive amounts of nutrients during pregnancy may "condition" an infant to a higher than normal need.

5. No figures of toxic levels of minerals are available for pregnant women, but toxic levels for many of the trace elements may not be much higher than usual intakes.

Megadoses are considered to be pharmacologic in strength; that is, they act more as drugs than as nutrients (3).

It is recommended that the 1983 Recommended Nutrient Intakes Table in Chapter V be used as a guideline for evaluating quantities of vitamin and mineral supplements. Supplements should not exceed those amounts unless the need has been carefully assessed and the person has received nutrition counselling.

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CHAPTER II

PREGNANCY OUTCOME FOLLOWING NUTRITION INTERVENTION

GUIDELINES AND SUMMARY

Nutrition plays a preeminent role in determining the well-being of mother and fetus. It is important in itself and through its interrelationships with many other factors influencing pregnancy outcome. Nutrition intervention during pregnancy has resulted in significant improvements in infant birth weights, as well as reduction in the incidence of low birth weight and in the perinatal mortality rate. Birth weights under 2500 grams are associated with cerebral palsy, epilepsy, mental retardation, visual and hearing disabilities, behavioural disorders, illness and learning problems. In B.C. in 1982, 2,233 infants (5.2%) weighed less than 2500 grams. The B.C. perinatal mortality rate in 1982 was 12.4 per 1000 (535 infant deaths). Nutrition intervention is a cost effective way to reduce infant mortality and morbidity.

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FACTORS INFLUENCING PREGNANCY OUTCOME

For the mother, pregnancy is part of a continuum that begins with her own birth (1). Pregnancy outcome is influenced by many factors. Nutrition is acknowledged to be an important factor in itself and is related to many other factors, thereby playing a preeminent role in determining the well-being of mother and fetus.

Factors influencing pregnancy outcome include:

- Socioeconomic Status
- Genetic Endowment
- Use of Health Care Services
- Response to Stress
- Caffeine Intake
- State of Health During Pregnancy

Nutrition
Physical Fitness
Alcohol Consumption
Cigarette Smoking
Use of Drugs
Preconceptional Health
Motivational State, Attitude
Infections
Environmental Hazards

The relative importance of these factors is as yet unknown. It is difficult to precisely determine nutritional influences on reproduction because it is impossible in human studies to isolate nutrition from all the other factors influencing pregnancy (2). The importance of preconceptional nutrition further complicates any precise correlation between gestational nutrition and the course and outcome of pregnancy (1). More information is needed on factors which influence the reproductive health status of males.

There has been much discussion about the effect of maternal ethnic origin on birth weight. Whether there are true ethnic (genetic) differences in fetal growth or whether nutritional differences are influential remains to be investigated (3).

THE SIGNIFICANCE OF LOW BIRTH WEIGHT

Birth weight is considered to be the single most important determinant of the survival and health of the newborn (2).

A "low birth weight" (LBW) infant may be appropriate-for-gestational age or small-for-gestational age. Obviously, any LBW infant who is appropriate-for-gestational age will be pre-term (delivered before the 37th week of gestation). Small-for-gestational age infants include both pre-term and term infants, since intrauterine growth retardation may exist at any gestational age.

Anthropometric measurements give clues to the etiology of growth retardation. When length, head circumference and weight are in normal proportion to each other, fetal growth may have been at a consistent, though reduced, rate throughout gestation. This infant probably has a general reduction in cell numbers in all organs and uniformly limited biochemical function. However, when length is proportionally greater than weight and head circumference, it implies that fetal growth was normal or close to normal during the first two trimesters and that the interruption in growth occurred in the third trimester when weight and head growth would normally have accelerated. If the only deficit is in weight and the skin appears loose, this suggests an actual loss of weight late in pregnancy after it had been acquired, and that total number of cells will be close to normal.

In past studies, all of these infants have been considered as one group. In future studies, recognition of the heterogenicity of growth retardation, together with improved measures of fetal growth will increase our understanding of what is normal or inadequate (4). As Rosso points out, however, it is impossible to recognize minimal deviations from genetically determined growth channels (4).

Worthington-Roberts has summarized the risks of LBW (5). LBW infants have a greater risk of perinatal mortality. LBW is a known etiological factor in some forms of cerebral palsy, and it has been implicated in epilepsy and various forms of mental retardation. There is also evidence that, as a group, children who were extremely undersized at birth have more frequent hospitalizations for illness, more visual and hearing disabilities, more behavioural disorders, and more learning problems when they enter school.

In a study comparing average birth weights of infants from private and public patients at a Montreal hospital, a 120 gram difference was found in favor of infants born to private over public patients (6). This seemingly small difference (4 ounces) accounted for a 50% higher incidence of perinatal mortality and a 60% higher incidence of low birth weight among infants of public patients.

The number of infants under 2500 grams born in B.C. in 1982 was 2,233 (5.2%) of total births (7). The perinatal mortality rate (deaths per 1,000 births) in B.C. in 1982 was 12.4 (535 infant deaths).

The lowest rates of perinatal mortality occur when infants weigh between 3501 and 4000 grams (7 pounds, 11 ounces and 8 pounds, 12 ounces) (5). In B.C. in 1982, 23,468 infants (54.6%) weighed less than 3500 grams. The percentage of infants weighing more than 4000 grams was 13.5% (7). There is little known regarding the health or health risks of this group of larger babies.

THE EFFECT OF NUTRITION INTERVENTION ON LOW BIRTH WEIGHT

Nutrition intervention has a positive influence on birth weight. A review of studies between 1970 - 1980 has been prepared by Rush et al. (8). Rosso (9) states that the benefits of nutrition intervention have been underestimated because researchers have looked only at increases in birth weights, and have not taken into account the weight retained by the undernourished mother. In some studies, the intervention (food supplementation) was aimed at underweight mothers but the weight gain of the mothers was insufficient to cause a significant increase in mean birth weight.

The results of two Canadian studies show significant improvements in birth weights following nutrition intervention (6, 10).

In a Vancouver study, 213 at risk pregnant women were given one-to-one nutrition counselling in their homes by Nutrition Aides. The average birth weights of the infants born to the study group was 3357 grams compared to 3300 grams for total Vancouver births. The program demonstrated that it is possible for high risk groups to achieve birth outcomes equal to or better than the overall population.

At the Montreal Diet Dispensary, 1736 pregnant women were counselled between 1963 and 1972. Birth weights of the infants born to these mothers were compared with birth weights of their siblings born when their mothers did not receive nutrition intervention. Birth weights of the treated siblings were significantly higher ($p = .01$) than birth weights of the non-treated siblings. Adjustments were made for age of mother, parity and sex of offspring.

In both the Vancouver and Montreal studies, the earlier the mother received nutrition counselling, the higher the infant birth weights.

ECONOMIC BENEFITS OF NUTRITION COUNSELLING FOR PREGNANCY

Costs have been examined in relation to the incidence of low birth weight. The number of LBW (2500 grams) infants born in B.C. for the period 1971 - 1979 was 19,795, 6.1% of total births. Of these, .4% weighed 1000 grams or less (7). The cost of intensive neonatal care, alone, for this group is calculated to be 43.6 million (1976 U.S. dollars) (11). The best attainable LBW rates are believed to be 2-3% (12).

The estimated average cost for the lifetime care of a handicapped person in Canada is $750,000 (13). If this sum is applied to the 20% of B.C.'s LBW infants that are born mentally or physically handicapped, the annual cost is $360 million for each year that the LBW rate remains at 6.1%. This figure does not take into account the fact that the survival rate of LBW infants is increasing with improved neonatal care, the inflation of costs, nor perhaps most important, the incalculable cost of human suffering.

Nutrition intervention can contribute to a reduction in the incidence of low birth weight and to a reduction in perinatal mortality. The effectiveness of nutrition counselling at this time in a woman's life is, with respect to the time and cost involved, of an extremely high order (14).

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CHAPTER III

IDENTIFYING AND COUNSELLING WOMEN WHO NEED NUTRITION INTERVENTION FOR PREGNANCY

GUIDELINES AND SUMMARY

Nutrition assessment is an essential component of prenatal care. Ideally, it is done prior to pregnancy. Failing that, it should be done as early in pregnancy as possible. The purpose of the assessment is to identify those women who, due to their nutritional status and/or lifestyle choices, are nutritionally at-risk and therefore may compromise their personal health and their infant's well-being.

Nutrition counselling consistent with the results of the assessment should be provided.

For those women not nutritionally at-risk, nutrition counselling and follow-up for continued health during the pregnancy may be provided by a physician or a nurse.

Intensive nutrition counselling and follow-up by a dietitian/nutritionist may be indicated if certain conditions are discovered through a nutrition assessment. Conditions which may signal the need for intensive nutrition counselling are outlined in Table I, page 72. However, nutrition assessment and counselling of pregnant women are developing areas of health care. For some of these conditions specific guidelines for assessment and counselling are not yet established.

A method of intensive nutrition counselling for pregnant women has been developed at the Montreal Diet Dispensary. It is recommended as a guideline for developing or revising nutrition counselling programs in British Columbia. A brief description of the method is included in Appendix A.

Methods of assessing food and nutrient intake as a basis for nutrition counselling are presented in Appendix B.

The following principles are important in nutrition assessment and counselling for pregnancy.

1. Undernutrition

Maternal undernutrition from calorie and/or nutrient deficiencies affects the survival, growth, development and intellect of the child as well as the health status of the mother. The fetus does not act as a parasite as was formerly believed.

Undernutrition may occur in women of all weight categories and socioeconomic levels.

2. Weight

Women should be counselled to improve nutritional status and to attain a desirable weight for height well prior to conception.

To assess whether a women is underweight (less than 90% of desirable weight for height), or overweight (more than 120% of desirable weight for height), refer to the Tables in Appendix D.

If a woman is underweight and pregnant, she must be counselled to gain the weight required for the pregnancy in addition to the number of pounds she was under desirable weight for height at conception.

The aim of nutrition counselling in the overweight pregnant woman is not to restrict weight gain but to emphasize the selection of nutritious foods. Her overweight status should be corrected after pregnancy and lactation are terminated.

A Table of Expected Weight for Date in pregnancy is included in Appendix D. A woman who weighs less than 100% of the weight in the Table may be at risk of delivering a baby of less than optimal birth weight.

If the rate of gain is inappropriate (refer to Chapter IV), it is important to assess the woman's food intake to determine whether the inappropriate gain is nutritionally based. For example, women with poor diets may have rapid weight gain due to fluid retention; restriction of food intake would be harmful.

A sudden shift in weight gain after the twentieth week is usually an indication of preeclampsia. Toxemia (preeclampsia and eclampsia) is a disease of malnutrition and may be prevented by attention to adequate calories, protein, vitamins and minerals (including salt) in the diet.

Diuretics and salt restriction are not recommended for pregnant women.

3. Anemia

Prevention of iron and folate deficiency anemia should begin long before conception through consumption of good food sources of these nutrients.

Both low and high hemoglobin and hematocrit levels are related to poor pregnancy outcome. Hemodilution, the dilution of iron levels by increasing blood volume, should be taken into consideration in assessing the iron status of pregnant women.

4. Age

In assessing the adolescent's need for nutrition intervention, the age of menarche is an important consideration. Fewer than five years past menarche should be regarded as a signal for intervention. More than five years past menarche is the time of healthiest pregnancies for adolescents.

The woman over 35, like the adolescent, must be assessed individually. It may be that general health and nutritional status are much more important than age alone in predicting pregnancy outcome.

5. Nutrient Stores

An inter-pregnancy interval of 12-24 months is recommended to replenish nutrient stores.

A woman who has been using oral contraceptive agents should be advised to use another method of birth control for a minimum of four months before becoming pregnant and to select foods high in B vitamins, vitamin C and zinc.

It is possible for those women of lower socioeconomic levels who have had poor quality diets to have pregnancy outcomes similar to women of higher socioeconomic levels if appropriate nutrition intervention is provided and the degree of compliance to the dietary prescription is high.

6. Increased Nutrient Needs

Severe psychological stress increases calorie and nutrient needs.

If a woman is physically active, either at work or at play, the calorie and nutrient requirements for activity must be added to her pregnancy requirements.

The nutrient requirements for women expecting twins or triplets have not yet been determined. Good results have been achieved at the Montreal Diet Dispensary where the additional calorie and protein requirements for pregnancy are doubled for women expecting twins and tripled for women expecting triplets.

7. Obstetrical History

Women who have had a previous low birth weight infant, premature infant, stillbirth or abortion have a greater risk of producing a low birth weight infant. Nutrition intervention is recommended to optimize nutritional status.

The Spina Bifida Clinic of the B.C. Children's Hospital in Vancouver should be contacted regarding a specific vitamin supplementation program for women who have given birth to a child with a neural tube defect.

8. Contact with Hazardous Substances

A less than optimal nutritional state creates an environment in which hazardous substances such as alcohol, cigarettes and drugs can exert their negative influences to greatest effect. Refer to Chapter I for further information.

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NUTRITION ASSESSMENT AND COUNSELLING

Ideally, nutrition assessment for pregnancy is done prior to conception. Realistically, a routine nutrition assessment should be done as early in pregnancy as possible, such an assessment involves(1):

- clinical observations and physical examination
- laboratory tests of nutritional adequacy
- history including nutrition history.

These basic methods of assessment are described in Worthington-Roberts "Nutrition in Pregnancy and Lactation" (2). Some of these assessment techniques are now a routine part of prenatal care (height-weight assessment, hemoglobin testing, etc). Nutrition assessment for pregnancy is a developing area and much remains to be learned, especially about laboratory tests of nutritional status. Skills in this area are improving and there are interesting new developments. A 1981 report by Metcoff describes a measurement of maternal leucocytes (rapidly replicating cells, constantly maturing in the bone marrow) as an indicator of maternal nutritional status (3). Nutritional assessment can help identify underlying circumstances which may prevent a woman and her fetus from being optimally nourished. Nutrition counselling may result in an improved diet prior to and during pregnancy and may rehabilitate a woman who has previously been poorly nourished; thereby increasing the chance of providing the best possible environment for the fetus, as well as exerting a positive influence on the woman's own health.

Some of the factors which may be uncovered by a nutrition assessment are listed in Table I, page 72. In the presence of any one, or a combination of the factors in Table I, intensive nutrition counselling and follow-up by a dietitian/nutritionist may be indicated.

One method of intensive nutrition counselling which has resulted in improved pregnancy outcome is that used by the Montreal Diet Dispensary (Appendix A). It is recommended that this method serve as a guideline for developing or revising nutrition counselling methodology for pregnant women in British Columbia.

Methods of assessing food and nutrient intake as a basis for nutrition counselling are presented in Appendix B.

TABLE I

CONDITIONS WHICH MAY SIGNAL THE NEED FOR INTENSIVE NUTRITION COUNSELLING

CONDITIONS	EXAMPLES
I. INADEQUATE FOOD OR NUTRIENT INTAKE	A. Undernutrition B. Anemias C. Chronic Disease D. Restrictive Diets
II. INADEQUATE NUTRIENT STORES	A. Low Prepregnancy Weight B. Chronic Dieting or History of Obesity C. Age (adolescents, women over 35) D. Short Inter-pregnancy Interval E. Contraceptive Use F. History of Poverty
III. INCREASED NUTRIENT NEEDS	A. Infection B. Stress C. Multiple Births D. Increased Physical Activity
IV. INAPPROPRIATE WEIGHT GAIN	A. Inadequate Gain B. Excessive Gain C. Inappropriate Rate of Gain
V. POOR OBSTETRICAL RECORD	A. Previous Low Birth-Weight Infants, Premature Infants, Stillbirth or Previous Abortion B. History of Neural Tube Defect
VI. CONTACT WITH HAZARDOUS SUBSTANCES	A. Alcohol B. Smoking C. Caffeine D. Some Herbal Teas E. Drugs F. Environmental Hazards G. Excessive Vitamin or Mineral Intake

A discussion of each of the conditions in Table I follows.

INADEQUATE FOOD OR NUTRIENT INTAKE

Undernutrition

In the past, only the *severely* undernourished woman was a concern. The fetus was regarded as a parasite who would preferentially receive needed nutrients from a *moderately* undernourished mother. Recent evidence suggests that the fetus is proportionally more affected than the mother who is undernourished (4).

An undernourished person is not always underweight. An individual of normal weight may appear to be healthy, but may in fact be undernourished. Overweight women with a low intake of nutrient-dense foods may also be undernourished.

In a culture that emphasizes slimness, women may have restricted caloric intakes which increase the risk of broad nutrient deficiencies.

Experimental data from animal and human studies confirms that nutritional deprivation of the mother results in offspring with abnormalities in brain size, structure and function as well as decreased body weight and organ size (5,6). In general, the earlier the undernutrition occurred and the more prolonged and more severe it was, the greater and less reversible were the abnormalities.

Individual nutrient deficiencies also create deficits in the fetus or the mother. For example, insufficient calcium may result in decreased bone density in the infant (7) and osteomalacia in the mother (8). Low plasma levels of vitamin D have been found in some instances of early neonatal hypocalcemia suggesting that maternal vitamin D deficiency may be responsible (7). Nutrition counselling and follow-up is recommended for women whose diets are or have been low in calories, protein or other nutrients. At the Montreal Diet Dispensary, a corrective factor is used in the dietary prescription for undernourished pregnant women (see Appendix A).

Anemias

The term "anemia" stems from a Greek root meaning "want of blood". Anemia may be defined as a significant reduction in hemoglobin and red blood cells. Oxygen binds with the iron of the heme part of the hemoglobin molecule and is transported throughout the body to assist in cell metabolism. Because of this vital function of hemoglobin, the signs and symptoms of anemia include pallor, fatigue, anorexia, weakness, lassitude, dyspnea and edema (9).

A physiological anemia occurs during pregnancy as a result of increased blood volume. The increase in plasma volume begins at about three months' gestation, reaches maximum level in the ninth month, decreases slightly at term and returns to normal by about three months postpartum. As a result of the increased blood volume, a hemodilution occurs, which makes accurate diagnosis of anemia difficult.

Garn, in a study involving 50,000 pregnancies, has reported that both low (less than 10 grams per 100 millilitres) and high (more than 12 grams per 100 millilitres) hemoglobin levels increase the probabilities of fetal death, short gestation length, low birthweight and low Apgar scores. The same was found for hematocrit levels of less than 27 and more than 41 (10). Garn suggests that the low hemoglobin and hematocrit levels may result from iron or folate deficiency, poor nutritional levels, recurrent infections and the concomitants of poverty. The end result of these levels is a diminished efficiency in the transport of oxygen and carbon dioxide and of nutrients. The relationship between high hemoglobin and hematocrit levels and poor outcome may result from an inadequate expansion of blood plasma volume (10). Rosso has suggested, based on his work with pregnant rats and studies of morphological changes in human placentas, that insufficient food intake may interfere with the normal expansion of blood volume (11).

Anemias may be classified as acquired (such as iron or folate deficiency anemia, anemia caused by infection) or hereditary (such as sickle cell anemia). Of the acquired anemias, those with the greater nutritional significance in pregnancy are iron and folic acid deficiency anemias.

1. Iron Deficiency Anemia

Over 75% of the anemias in pregnancy results from iron deficiency. Women through the menstrual years are highly vulnerable to iron deficiency. Pregnancy places a demand on their already tenuous iron balance (9).

Prevention of iron deficiency begins with adequate iron intake. The 1983 Canadian recommended iron intake for the adult woman is 14 milligrams. During pregnancy the recommended intake is 15 milligrams for the woman with good iron stores and 20 milligrams if stores are very low or absent at the beginning of pregnancy (12).

To meet iron requirements, care in food selection is needed. Foods high in iron are listed in Appendix C together with information on how to enhance iron absorption.

Treatment of iron deficiency anemia includes food sources of iron together with an iron supplement, with amount depending on the severity of the anemia (9).

2. Folic acid deficiency anemia

In folic acid deficiency anemia or megaloblastic anemia, red blood cells are larger than usual and immature. Folic acid deficiency anemia can exist as a single deficiency but is most commonly found in association with iron deficiency (9).

To prevent deficiency, a diet high in folic acid prior to pregnancy and during pregnancy is recommended. The recommended folate intake is increased to 470 ug from the non-pregnant requirement of 165 ug. Food sources of folic acid are listed in Appendix C.

Treatment of folic acid deficiency anemia includes food sources of folic acid together with a folic acid supplement.

Chronic Disease

A pregnant woman with a chronic disease or other medical condition such as diabetes mellitus, heart disease, liver or kidney disease, arthritis, thyroid malfunction or gastrointestinal disorders requires special attention to food and nutrient intake. These disorders may interfere with the ingestion, digestion, absorption or utilization of nutrients. The drugs used to treat these conditions may also affect the person's nutritional status. For guidance in these areas a clinical dietitian should be consulted. A good discussion of therapeutic nutrition in special conditions of pregnancy is found in "Nutrition in Pregnancy and Lactation" by Worthington-Roberts, et al. (13).

Restrictive Diets

Reducing diets, poorly planned or inadequate diets can result in a deficient intake of calories or nutrients, and can present a serious risk to the mother's health and to the development of the fetus. A pregnant woman who restricts caloric intake restricts nutrient intake. She risks delivering an infant of lower weight than optimal in addition to compromising her own health .

Fasting leads to ketosis, detected by the presence of acetone in the urine. The effect of ketosis on the fetus is unknown, and women should be advised not to fast during pregnancy (14).

Women who are new to this culture may have restricted diets if they are unable to find familiar foods and have not made substitutions with available food to supply calories and nutrients needed for pregnancy.

The intake of nourishing food may be restricted by pica. Pica is an unusual craving for nonfood items such as clay, chalk, dirt, starch or paper. One serious consequence of pica is the blocking effect of the substances ingested on the absorption of nutrients. Pica is usually accompanied by a deficiency of iron but it is still unclear which is cause and which is effect. Iron deficiency should be investigated in these cases (15). It is also necessary to check caloric intake which may be jeopardized by pica.

INADEQUATE NUTRIENT STORES

Low Prepregnancy Weight for Height

Women who are under desirable weight for height at conception are at risk of producing infants that are premature, have low birth weights and low Apgar scores (6). Underweight status prior to pregnancy in combination with anemia has been found to be associated with a five-fold increase in the incidence of low birth weight (16). In a study of 26,468 pregnancies in Houston, Texas, as pre-pregnancy weight increased there was an associated increase in birth weight and a decline in low birth weight infants (17).

The woman is at risk if her weight is below 90% of her desirable weight for height or if she weighs less than 45 kilograms (99 pounds) (17). An underweight woman should be advised to attain her appropriate weight for height prior to conception. If a woman is underweight when she becomes pregnant, she should be coursel1ed to gain the weight required for pregnancy plus the additional amount that she was underweight prior to pregnancy (18). For further information, refer to the chapter entitled "Weight Changes in Pregnancy".

A chart for determining whether or not a woman is under desirable weight for height is included in Appendix D.

Chronic Dieting or History of Obesity

A prepregnancy history of chronic or extreme dieting suggests a lack of maternal nutrient stores. Dieting is common among the slim as well as the overweight.

Dietary fads include the "Dr. Atkins", "Scarsdale", "Beverly Hills", "Stillman" and "Macrobiotic" regimens. In addition to being nutritionally inadequate, they may produce metabolic changes including kidney disorders, gout and scurvy (19).

Nutrition counselling is recommended for a woman who is above 120 percent of her desirable weight for height, not to restrict weight gain during pregnancy, but to assure that her food intake meets her caloric and nutrient needs to bring about an appropriate rate of gain (20). The overweight mother has an increased chance of developing complications associated with hypertensive-cardiovascular disease, and diabetes mellitus (21).

Weight gain guidelines for the overweight woman are discussed in the "Weight Changes in Pregnancy" chapter of this manual.

Age

1. Adolescents

Eight percent of the total births in B.C. in 1981 (3,318 infants) were born to women aged 19 and under. As shown in Figure 1, this group had a higher percentage of lower birth weight infants than women in their 20's (22).

Figure 1

Birth Weights of Infants of Adolescents
Compared to Women in their 20's

Age (years)	% under 2500 grams	% between 2500-3000 grams
19 and under	6%	17%
20-29	5%	14%

Zackler's report on the young adolescent shows that the stress of pregnancy is great at this critical period of growth and development (23). A teenager has the greatest chance of producing a low birth weight infant if she is within three years of her menarche. More than five years past menarche is the time of healthiest pregnancies for adolescents (24).

The age of menarche is also significant in that it may be delayed by poor nutrition in early childhood. Scanty flow and episodes of amenorrhea in adolescence can suggest poor nutrition. Obesity or anemia during the teens also suggests poor nutritional status (25).

Other aspects, besides reproductive biological age, may put the adolescent at nutritional risk during pregnancy. Economic problems, smoking habits, a desire to hide the pregnancy, rejection by the parents or inadequate prenatal care all may contribute to a nutritionally deprived environment for the fetus (25).

Many adolescents have positive pregnancy outcomes. Grant and Heald (26) advise that erroneous conclusions may be drawn from studies in large medical centers which attract a large number of abnormal cases with racial or socioeconomic bias and that demographic characteristics may be more important determinants of obstetric complications than age.

Weight gain guidelines for adolescents are discussed in the "Weight Changes in Pregnancy" chapter of this manual.

2. Women over 35

The pattern of reproductive loss by age is a U-shaped curve, with infant mortality elevated in those below 15 and over 35 years (27). The reasons for higher perinatal mortality and morbidity among older women are not clear but may arise from a combination of advanced age, hormonal insufficiency, chromosomal damage and nutrition depletion (28).

Some older pregnant women have a longer history of poor eating habits or contraceptive use. In some cases, factors such as high alcohol intake and/or low activity levels, combined with a slimming diet may lead to poor nutrient stores.

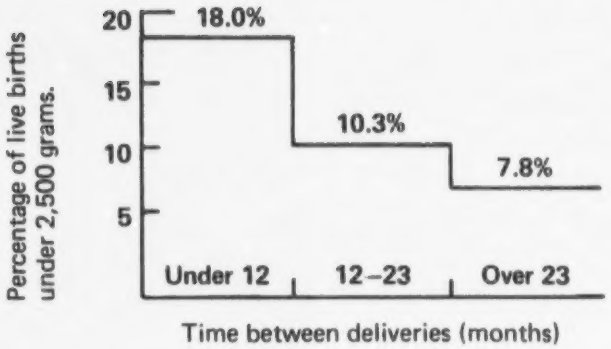
The older woman, like the adolescent, must be assessed individually. It may be that general health and nutritional status are much more important than age alone in predicting pregnancy outcomes.

Close Inter-pregnancy Interval

Closely spaced pregnancies are related to low birth weight infants, both premature and small for gestational age, as shown in Figure 2 (29).

Figure 2

Relationship Between Pregnancy Spacing and Percentage of Births under 2500 Grams (29)



Percentage of births under 2,500 g by spacing. Philadelphia,1956–61, 16,000 consecutive births, 9.8 per cent 'premature' (Source: Bishop, 1964)

This effect of close pregnancies is interpreted to be the depletion of those nutrient stores which may occur whether the pregnancy results in a birth, a therapeutic abortion or a spontaneous abortion. Low income women may have lower nutritional reserves which are depleted more quickly by pregnancy (30). An inter-pregnancy period of 24 months may be needed to replenish nutrient stores (31). In practice, waiting 24 months is not always possible (an older mother may choose not to) and 12 months may be sufficient if diet and lifestyle are optimally healthful.

Contraceptive Use

Research in this area indicates that the use of oral contraceptive agents (OCA) may lower the woman's nutrient levels of B vitamins (B_6, B_{12}, riboflavin, thiamin and folic acid), vitamin C and zinc (32,33,34).

It has been estimated that a period of 4 to 30 months is needed to allow the body to return to a normal nutritional state following termination of OCA use, an important consideration in conception planning (32). The length of recovery time varies with the nutrient measured, the length of time OCA are used and with the quality of the woman's diet while using OCA. A practical guideline for the woman is to use another method of birth control for at least 4 months after being on the pill before becoming pregnant, and to consume a diet conducive to recouping one's nutrient stores.

If a woman has a history of OCA use, additional food sources of the B vitamins, vitamin C and zinc are recommended. These are listed in Appendix C.

History of Poverty

Long term poverty may result in poor nutritional status. Studies have confirmed the relationship between low quality diets of poor women and a higher percentage of low birth weight infants, higher perinatal mortality and higher infant mortality (35).

In many cases, after basic expenses are paid (rent, hydro, transportation, household and personal needs), food may be the only flexible item in the budget. As the money available for food decreases, nutritional status may be compromised. Budget counselling is recommended.

Financial aid during pregnancy and the postpartum period is available from the B.C. Ministry of Human Resources. Women may contact the local M.H.R. office to determine their eligibility for assistance.

Poverty may contribute many factors which lead to poor pregnancy outcomes such as frequent infections and lack of health care (36). It is encouraging to know that three decades of experience at the Montreal Diet Dispensary shows that disadvantaged women can have pregnancy outcomes similar to those of advantaged women, if appropriate nutrition intervention is provided and the degree of adherence is high (37).

INCREASED NUTRIENT NEEDS

Infection

Multiple, frequent, or severe infections can interfere directly with a normal intrauterine growth pattern. The direct fetal effects include spontaneous abortion, fetal or neonatal death, growth retardation or severe malformations (38,39). Maternal infections can also lead to anorectic states that both reduce nutritional intake and place an additional catabolic load on maternal stores (40). Nutrition counselling is recommended.

Stress

Occupational stress is recognized in France as being related to an increased incidence of prematurity. In France's program to prevent handicaps, five indices of occupational fatigue are considered: posture, machinery, environment, physical and mental load (41). The fact that hard physical work may be done at home as well as in the work place should not be overlooked. In many jobs there is a wide range of physical and psychological stress (42). It is important to recognize that heavy physical work may use calories needed by the fetus for growth, particularly when women are undernourished (43). Naeye and Peters found that growth retardation of the fetus was most severe when mothers had stand-up jobs, continued working until near term, or had children at home to care for when they returned from work (44).

Psychological stress can be defined as stimuli and/or circumstances, either actual or imagined, that arouse anxiety. In what appears to be the first published attempt to determine the effect of psychological stress on energy consumption and utilization in pregnancy, Picone et al. found that although stress did not affect the average food intake of pregnant women, it correlated negatively with pregnancy weight gain. This suggests that energy utilization was greater in women under stress (45). For further information on nutrition and stress, refer to Chapter 1.

Multiple Births

Two or more fetuses place an additional demand on maternal nutrient reserves and blood supply. These pregnancies are associated with a considerable increase in perinatal deaths and in complications such as pre-eclampsia and anemia (46). In B.C. in 1981, 49% of twins born had birth weights below 2500 grams (47). It is recommended that the additional calorie and protein requirements for pregnancy be doubled for women expecting twins and tripled for women expecting triplets. This advice is given at the Montreal Diet Dispensary. Preliminary data from their study of twins, shows a significantly lower rate of Intrauterine Growth Retardation for twins of mothers who received nutrition intervention compared to twins of mothers in the control group (48).

Increased Physical Activity

Physical activity increases caloric and nutrient needs. Caloric and nutrient requirements for a women's activity level must be established before adding the requirements for pregnancy.

Physical activity increases the need for niacin, riboflavin and thiamin which are linked with energy metabolism (49). Some physically active people have a high protein intake. This increases the need for vitamin B_6 which is directly related to the dietary intake of protein (49). If a woman is extremely active or increases physical activity during pregnancy, nutrition counselling is recommended. For further information on nutrition and physical activity, refer to Chapter I.

INAPPROPRIATE WEIGHT GAIN

Inadequate Maternal Weight Gain

Inadequate maternal weight gain after the first trimester has been associated with lowered birth weight, intrauterine growth retardation, nausea and vomiting and fetal jeopardy (24). The highest percentage of fetal growth retardation has been shown to occur in underweight women with a low maternal weight gain (6). To evaluate the adequacy of weight gain one must consider:

1. the number of weeks pregnant
2. prepregnancy weight
3. height
4. skeletal size (small, medium, large) - remembering that some obese women appear large but have a small bone structure
5. quantity and quality of the diet
6. fetal growth.

A theoretical table of expected weight for height of adult women during pregnancy has been developed, and may be a useful reference (50). Gueri states that a woman weighing less than 100% of the expected weight for date in the table should be considered at risk of delivering a baby of unsatisfactory birth weight. Gueri's table is included in Appendix D.

Excessive Weight Gain

An upper limit of weight gain for a healthy pregnancy has not yet been defined. It is no longer believed that a high calorie intake (as reflected in weight gain) causes preeclampsia (51).

The main concern about energy intake above normal pregnancy needs is that it will result in the deposition of surplus fat, which, if not lost after each delivery may contribute to the long-term development of obesity. According to Hytten, this seldom happens. He quotes evidence from Aberdeen and Sweden which shows that parity has no independent long term effect on body weight (52).

An individual, however, may think of pregnancy as a time to overindulge, and may gain unnecessary weight. This attitude should be discouraged and guidance given in the selection of nutritious foods conducive to an appropriate rate of gain.

Inappropriate Rate of Gain

It is important that weight measurements be combined with a food habits assessment when weight gain deviates from what is expected. The assessment will rule out the potentially harmful effects of restricting food intake in overweight women with poor diets whose rapid weight gain may be due to water retention.

A rough guideline for monitoring weight change is a 1 to 2 kilograms (2 to 4 pounds) gain by 12 weeks gestation and .40 to .45 kilograms (14 to 16 ounces) decelerating slightly to .35 kilograms (12 ounces) per week toward the end of pregnancy. If a woman appears to be gaining less than this amount, nutrition intervention may be in order. A sudden shift in weight gain may be related to a large shift in water balance. If this occurs after the twentieth week it is usually an indication of preeclampsia (53).

There have been many theories about the etiology of toxemia (preeclampsia and eclampsia) which is responsible for the majority of maternal and fetal deaths (U.S. data) (54). Brewer (55-57) and other clinicians (58,59), have presented clinical and laboratory evidence that toxemia is a disease of malnutrition, and that the malnutrition affects the liver and its metabolic activities. Toxemia is classically associated with poverty although it may also occur in women who are not poor but have inadequate diets (56). Optimal nutrition (adequate calories, protein, vitamins, minerals, and salt to taste) helps to prevent and is used in the treatment of toxemia (53, 54, 56).

Diuretics should not be given during pregnancy to prevent or treat toxemia. Diuretics may successfully mobilize fluid in preeclampsia, but this is controlling a sign without modifying the cause. Diuretics are not effective and may be harmful. The use of diuretics has been related to the occurrence of maternal pancreatitis, severe hypokalemia, neonatal electrolyte imbalance, and other problems (60). The only pregnant patients for whom diuretics should be prescribed, if indicated, are women with congestive heart failure (60).

POOR OBSTETRICAL RECORD

Previous Low Birth Weight Infant, Premature Infant, Stillbirth or Previous Abortion

A previous low birth weight baby, premature infant or stillbirth indicates a greater likelihood of producing a low birth weight infant (24).

History of abortion (spontaneous or induced) increases the risk of perinatal mortality, prematurity and other complications in subsequent births (24). Nutrition counselling to optimize nutritional status is recommended.

History of Neural Tube Defect (NTD)

Anencephaly and spina bifida are etiologically related birth defects involving failure of closure of the primitive neural tube (61). Consideration may be given to supplementing women who have given birth to one child with NTD with a vitamin supplement including folic acid, vitamin C and vitamin A. There is some evidence from uncontrolled studies that vitamin supplementation has prevented NTD (62). In 1982, a controlled study by the Medical Research Council in Britain was begun which may help clarify the type of nutrition intervention, if any, which is required for the prevention of NTD. For information on NTD, the Spina Bifida Clinic of the B.C. Children's Hospital in Vancouver may be contacted.

CONTACT WITH HAZARDOUS SUBSTANCES

Information and counselling, if needed, should be available to women who are exposed to environmental hazards, who smoke, or who consume alcohol, caffeine, certain herbal teas, excessive vitamins or minerals or drugs. Nutrition counselling is also recommended. Less than optimal nutritional status creates an environment in which hazardous substances can exert their negative influences to greatest effect (63). (For further information, see Chapter I, "Preconception Nutrition, Pregnancy and Lifestyle Choices").

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CHAPTER IV

WEIGHT CHANGES IN PREGNANCY

GUIDELINES AND SUMMARY

The major determinants of birth weight are duration of pregnancy, maternal weight gain during pregnancy and maternal pregravid weight status.

The combined effect of low pregravid weight and low weight gain results in a higher incidence of low birth weight than does low weight gain alone.

Positive outcomes occur with wide variations in pregnancy weight change. The focus should be on the quality of the gain and the foods consumed to bring it about.

The "average" weight gain of 11.4 kilograms (25 pound) during pregnancy was derived from data including both healthy and unhealthy women and should not be thought of as a "normal" weight gain for all women.

Healthy primigravidae eating without restriction gain an average of 12.5 kilograms (27.5 pounds). Multigravidae gain an average of 11.6 kilograms (25.5 pounds).

Underweight women need to gain enough weight to correct for their underweight status in addition to their pregnancy weight gain. Weight gains of underweight women average 13.6 to 14.5 kilograms (30-32 pounds).

Overweight women may not need to gain as much as normal weight women. A gain of 7.3 to 9 kilograms (16 to 20 pounds) is suggested, but there is too little information to make a firm recommendation. Weight reduction diets during pregnancy are harmful.

There is little published information on adolescent weight gain. Preliminary work shows that adolescent weight gains average 13.6 - 15.9 kilograms (30 to 35 pounds).

The rate of gain is a useful index. A rule of thumb for the normal weight adult woman is approximately 1 to 2 kilograms gain (2 to 4 pounds) by the end of the first trimester (12 weeks) and afterwards approximately .40 to .45 kilograms (14 to 16 ounces) per week and decelerating slightly to .35 kilograms (12 ounces) per week toward the end of pregnancy. A sudden increase in gain often indicates fluid retention which may result from an inadequate food intake.

Some women may exhibit a pattern of rate gain different from that of the normal weight adult woman; for example, the underweight or overweight woman, those who lose weight at some time during pregnancy, and adolescents.

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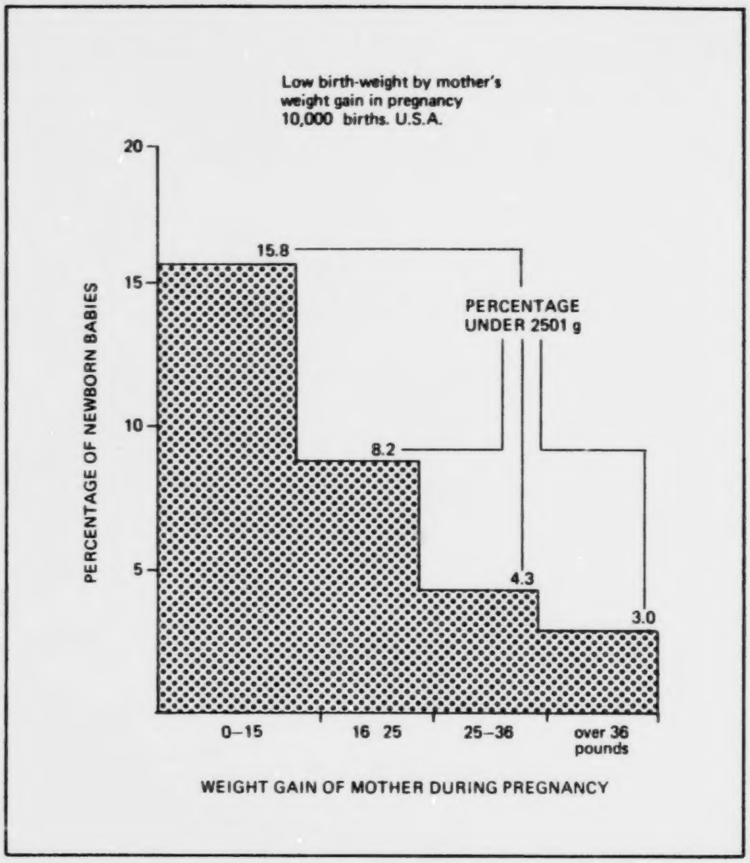
THE SIGNIFICANCE OF WEIGHT GAIN AND PREGRAVID WEIGHT STATUS

There is general agreement that the three major determinants of birth weight are (a) duration of pregnancy, (b) maternal weight gain and (c) pregravid weight status (1). It is important to consider, however, that weight gain is a crude index of nutrition, providing more information about energy intake or fluid retention than nutrient intake. Birth weight is a similarly gross index of fetal development (1).

Figure 1 (page 95) illustrates the positive relationship between higher maternal weight gains and the lower incidence of low birth weight infants (2). The combined effect of low pregravid weight and low weight gain results in an even higher incidence of low birth weight than does low weight gain alone (3-6).

Figure 1

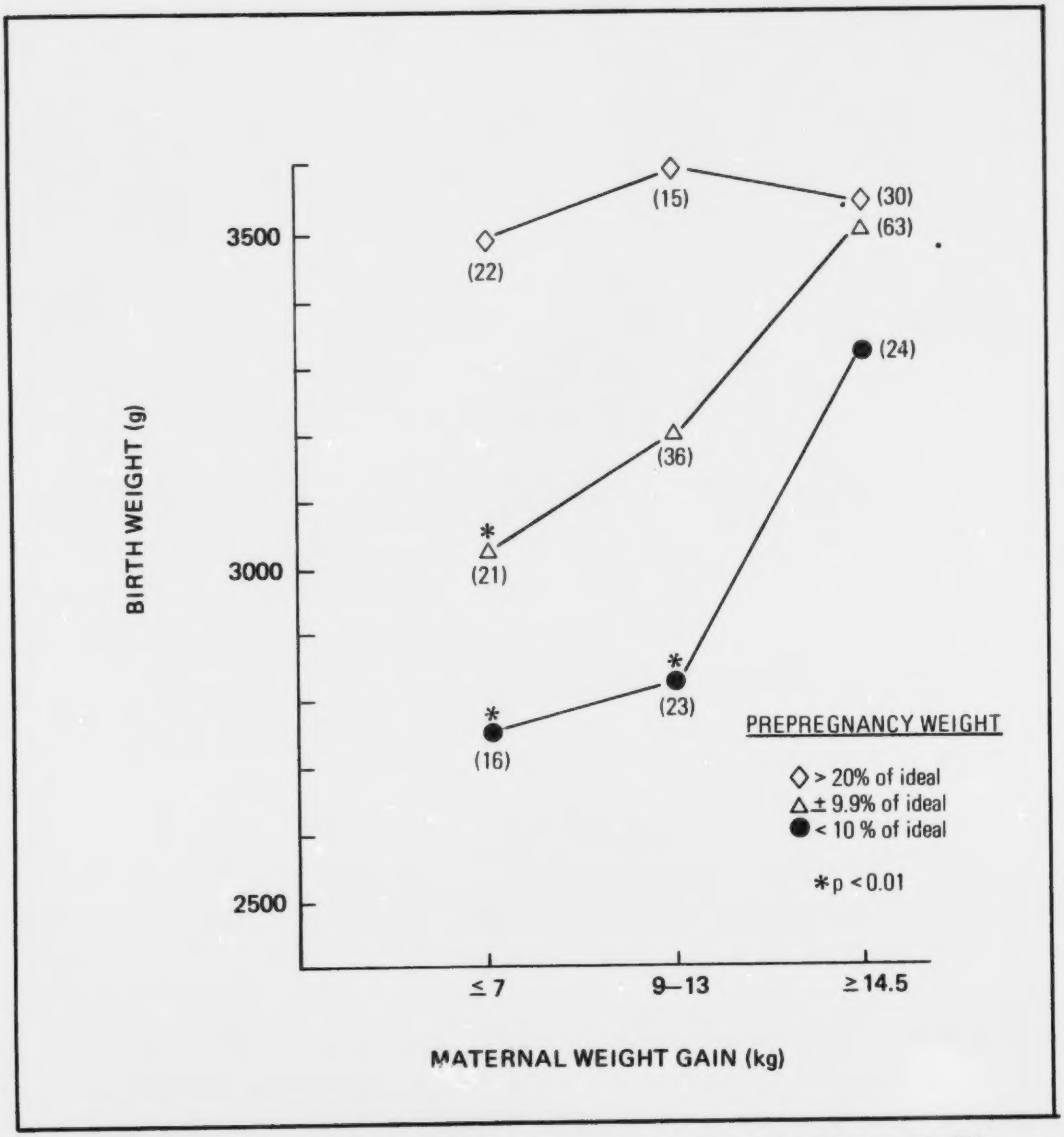


Source Niswander and Gordon
The Collaborative Study, 1972.

Figure 2 (page 96), from a study by Rosso, illustrates the additive effect of prepregnancy weight and weight gain. Only non-smoking women with uncomplicated pregnancies, no medical conditions and who had term deliveries were included in the analysis (6).

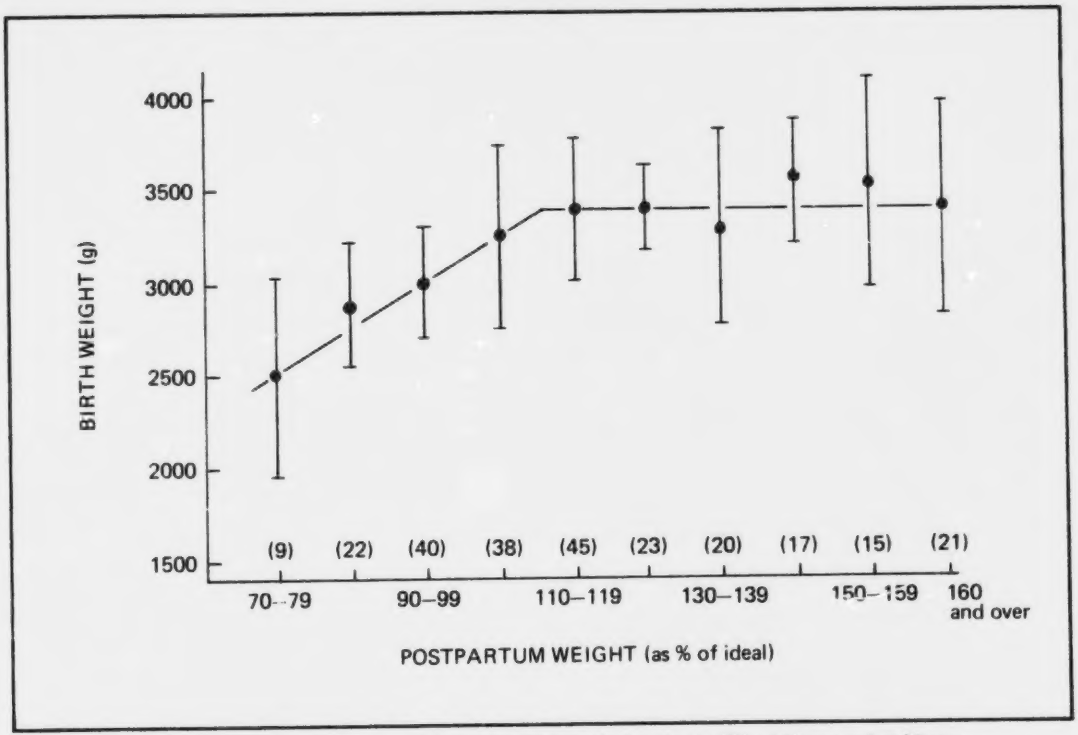
Rosso (6) also recorded mean maternal postpartum weights and found that they correlated linearly with mean birth weights until the postpartum weights were 110% of ideal body weight (Figure 3, page 97). The data suggests that mothers who have a postpartum body weight at least 10% higher than their ideal body weight provide the fetus with an optimal maternal environment (6). The mean birth weight of the infants of those mothers was 3450 grams, close to the desirable average.

Figure 2



Influence of prepregnancy weight and weight gain during pregnancy on mean birth weight at term in 254 low--income primiparas and multiparas. Numbers in parentheses represent number of subjects.

Figure 3



Postpartum weight, expressed as percent of ideal body weight and mean birth weight in 254 primiparas and multiparas. Values are mean ± S.D. Numbers in parentheses represent number of subjects.

COMPONENTS OF WEIGHT GAIN AND RATE OF GAIN

The average weights of the products of pregnancy are shown in Table 1 (7).

TABLE I

AVERAGE WEIGHTS OF THE PRODUCTS OF PREGNANCY

PRODUCTS	WEIGHT (lb.)	Weight (kg.)
Fetus	7.5	3.4
Placenta	1.0	.45
Amniotic fluid	2.0	.9
Uterus (weight increase)	2.5	1.1
Breast tissue (weight increase)	3.0	1.4
Blood volume (weight increase)	4.0	1.8
Maternal stores	4.0 to 8.0	1.8 to 3.6
Total:	24 to 28	10.9 to 12.7

Most of the gain during the second trimester is related to the maternal components and most gain during the third involves the fetal component (8).

For some time, the "maternal stores" component was believed to consist of only fat. It is now thought by some to consist of both fat and protein stores (9). This laying down of maternal stores is believed to provide reserves of energy to sustain fetal growth during the latter part of pregnancy and labor, birth and lactation (10). Restriction of this weight gain is physiologically unsound and potentially harmful (10).

The rate of weight gain is a useful index. A rule of thumb is approximately 1 to 2 kilograms gain (2 to 4 pounds) by the end of the first trimester and approximately .40 to .45 kilograms (14 to 16 ounces) per week and decelerating slightly to .35 kilograms (12 ounces) per week toward the end of pregnancy (7,11). A sudden increase in gain often indicates fluid retention which may result from an inadequate food intake.

FOCUS ON NUTRITION, NOT WEIGHT

One of the most striking features of weight change in pregnancy is its variability. The range is wide, from a loss, to a gain of 23 or more kilograms (51 or more pounds). A normal outcome is possible throughout, although complications increase at either end of the range (12). There is no single figure of weight change which can be regarded as "normal" with the implication that different figures are "abnormal" (12). There is, of course, an overall positive relationship between higher maternal gains and a lower incidence of low birth weight infants.

The published data on "average" weight gain includes a mixture of healthy and unhealthy pregnancies, and does not establish a "normal" standard (12). Hytten and Chamberlain, as a point of reference for normal weight gain use 12.5 kilograms (27.5 pounds), based on a review of the literature with special attention to studies of healthy primigravidae eating without restriction. There is little data on multigravidae gains, but it appears that the average multigravida gains about .9 kilograms (2 pounds) less than the average primigravida, i.e. 11.6 kilograms (25.5 pounds) (12).

The fact that healthy outcomes can occur within a wide range of weight change shows that the focus should be on nutrition rather than weight gain. A woman may gain weight on a non-nutritious diet, or lose fluid weight with a switch from a lower to a higher quality diet. Much of the data on pregnancy weight gain does not take into consideration the health of the women, maternal age, parity or nutritional status. In studies of obese women, it is not stated whether the extra weight is totally fat, partly fluid or related to a large lean body mass as seen in some very muscular women (13).

WEIGHT GAIN OF UNDERWEIGHT WOMEN

The woman who is under ideal weight for height at conception should gain enough weight to achieve her ideal non-pregnant weight for height in addition to the weight needed for the pregnancy. Ideally, a woman should be at an appropriate weight for height prior to conception, but often she is not aware of that, or is not counselled by a health professional to gain weight.

The pregnancy then, often occurs before her weight status is corrected. If a woman does not gain sufficient weight to correct her own non-pregnant weight for height status, as well as the weight required for pregnancy, she may add to her own tissue mass at the expense of the fetus (3,14,15). Brown has recently reported in a review of 654 prenatal cases, that the underweight women (less than 90% of ideal weight for health) who gained the same amount as the normal weight women (90 to 120% of ideal weight for height), delivered infants at a younger gestational age and of lower birth weight and length (5). Tompkins and Wiehl, the first researchers to publish data on this phenomenon in 1954, stated that "the underweight woman apparently adds to her own tissue mass at some sacrifice to the fetus"(15).

In the Montreal Diet Dispensary study the underweight women (in this case defined as less than 5% under ideal weight for height), seen between 1972 and 1975, were nutritionally rehabilitated with a dietary correction of 20 grams of protein and 500 kilocalories (2100 kilojoules) per day, in addition to normal pregnancy requirements to result in a gain of .45 kilograms (1 pound) per week. The kilocalorie need for the woman's own weight gain was added to her normal pregnancy requirements. The average weight gain for these women whose pregravid weight was lower than appropriate was 14.7 kilograms (32.4 pounds) (16). Naeye reported from an examination of the Collaborative Perinatal Study data that a gain of 13.6 kilograms(30 pounds) in underweight women was associated with the fewest perinatal deaths (17). Brown found that a gain of 15.8 kilograms (35 pounds) by those who began the pregnancy underweight was associated with birth weights of 3600 grams or more (5). If women with low pregravid weights for height are adequately nourished during pregnancy, they will gain more weight than women with ideal pregravid weights for height. If a woman is more than 10 per cent under desirable weight for height (see chart in Appendix D) the number of pounds she is underweight should be added to the number of pounds to be gained for the pregnancy. Her rate of gain should be monitored to achieve an appropriate total weight gain.

WEIGHT GAIN OF OVERWEIGHT WOMEN

Little is known about an appropriate weight gain for the woman who is obese (20% or more above ideal weight for height). There is general agreement that weight restriction is harmful (18-20).

Dwyer (11) has outlined the reasons for avoiding weight reduction diets during pregnancy:

- (a) limiting calories makes it impossible to provide the increased nutrients needed for pregnancy
- (b) if calories are limited, protein needed for growth may be used to provide energy
- (c) the ketonemia induced by rapid mobilization of adipose tissue may be undesirable for fetal brain development
- (d) There is no evidence that weight reduction lessens the risk of preeclampsia or eclampsia.

A safe and realistic goal is to keep gains within normal limits and to deal with the obesity after the baby is born (11).

Nutrition counselling is important for both the overnourished and the undernourished obese woman. Case studies of some undernourished obese clients counselled at the Montreal Diet Dispensary show that an increased intake of calories and protein may precipitate a weight loss (16). This suggests than an adequate calorie and protein intake maintains the expanding blood volume (21,22) and that fluid is lost from interstitial tissues.

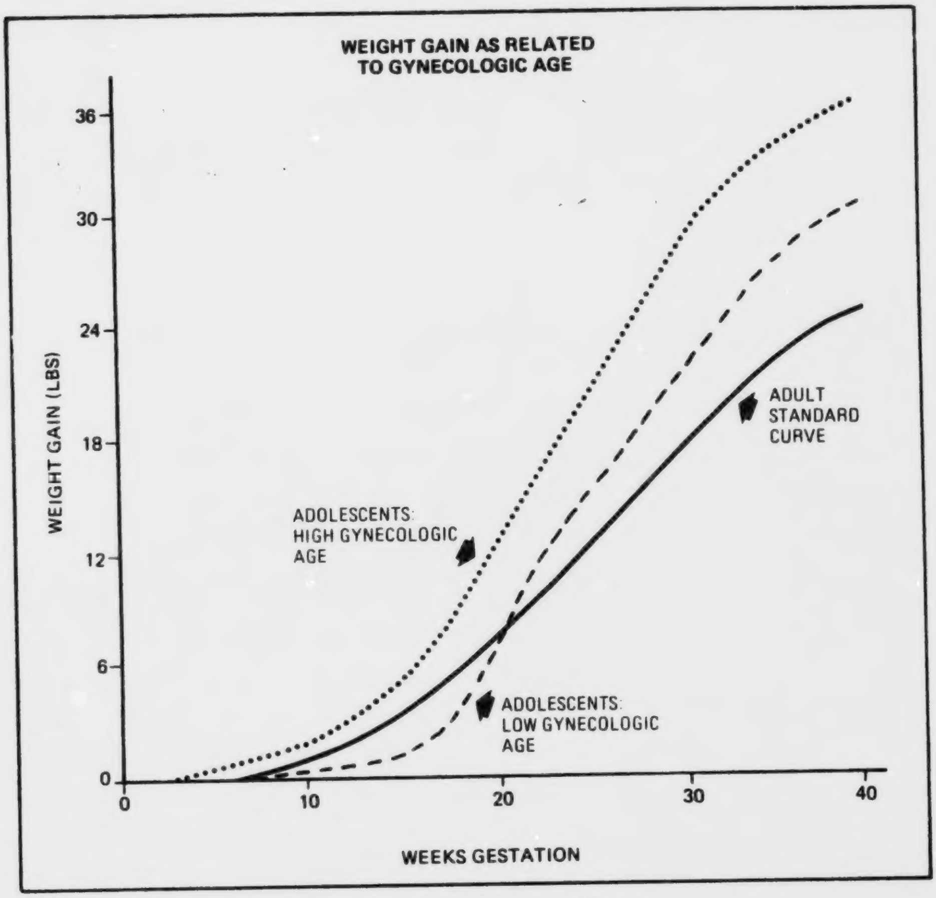
There has been some discussion about the necessity for the obese woman to gain the 1.8 to 3.6 kilograms (4 to 8 pounds) of "maternal stores". If weight gain were restricted by this amount, there is as yet no way to determine if some of the weight increase would go to "maternal stores" at fetal expense (19). Naeye found that the most favourable gain (related to the lowest perinatal mortality rate) for very overweight mothers (more than 135% overweight) was 7.3 kilograms (16 pounds) (17). This gain accounts for the weight of the products of gestation without the "maternal stores" component (23). Naeye cautions against restricting weight gain below 16 pounds because overweight women who gained less than this amount had a perinatal mortality rate twice as high as normal weight women with low weight gains (17).

A range of gain for obese women of 7.3 to 9 kilograms (16 to 20 pounds) is suggested, but a firm recommendation is not possible based on current knowledge.

WEIGHT GAIN OF ADOLESCENTS

The prenatal weight gain of adolescents differs considerably from average weight gain of adult women. In a University of Washington study (24), Worthington-Roberts found an average gain of 16 kilograms (35.2 pounds) for adolescents of high gynecologic age (greater than 2 years post menarche). Adolescents of low gynecologic age (less than two years post menarche) gained an average of 13.6 kilograms (30 pounds). Figure 4 shows the adolescent weight gain curves compared to the adult standard curve.

Figure 4



Source: Worthington–Roberts, B., University of Washington, 1982 (n=80)

The "more mature" adolescents gained more weight than the "less mature" adolescents who have more growth and development remaining. Worthington-Roberts suggests that anatomical or physiological immaturity of the adolescents of lower gynecologic age may limit deposition of maternal and/or fetal tissues as compared with those of higher gynecologic age (24).

Although the development of pregnancy weight gain grids for adolescents should ultimately be based on a larger population, this data suggests that weight gains for adolescents may average 13.6 to 16 kilograms (30 to 35 pounds). Adolescents of higher gynecologic age appear to gain more than adolescents of lower gynecologic age.

WEIGHT GAIN IN MULTIPLE PREGNANCIES

Very little information is available on weight gain for multiple births. When information becomes available, guidelines for health professionals will be prepared by the Nutrition Division, British Columbia Ministry of Health.

EVALUATING WEIGHT STATUS

Some difficulties in evaluating weight for height status are:

(a) there are no scientifically based height/weight tables available

(b) errors are made in judging appropriate frame size, and

(c) some people who are muscular appear overweight but are not overly fat.

In spite of these problems and limitations of currently available height/weight tables, the 1983 Metropolitan Life tables (Appendix D) may be used as a guideline. Although the weights are up to 4.5 to 6.8 kilograms (10 to 15 pounds) above those in the 1959 Metropolitan Life table, they may not be as generous as they seem. It is important to consider that the weights include 1.4 kilograms (3 pounds) of clothing for women and the heights include 2.54 centimetres (one inch) heels. Another important consideration in evaluating weight status is that those who exercise increase lean tissue mass and have higher weights. Earlier tables of standard weights have been criticized by the Wynns because the lower end of the average weight range which is 51.8 to 55.9 kilograms or 114 to 123 pounds for women of average height (5'4") fell in the penumbra (the weight status between infertility and good reproductive health). Women in the penumbra produce a higher percentage of low birth weight babies (25). The 1983 range is increased to 53.1 to 59 kilograms or 117 to 130 pounds. The lower end of this range is further from the penumbra in the 1983 Metropolitan Life tables.

To evaluate weight-for-height status by week of pregnancy, Gueri's reference table (Appendix D) is useful (26). It is based on the premises that:

(a) the average increment in weight during pregnancy should be 20% of the desirable prepregnant weight,

(b) the average increase during the first trimester is 1.7% of the prepregnancy weight and

(c) the remaining 18.3% is achieved at a rate of 0.678% of the prepregnancy weight per week during the second and third trimesters.

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CHAPTER V

ENERGY AND NUTRIENTS IN PREGNANCY
REQUIREMENTS, FUNCTIONS, FOOD SOURCES

GUIDELINES AND SUMMARY

Nutrient needs increase during pregnancy to accommodate an escalation of seven metabolic processes in the body. These processes, and the major contributing nutrients are:

1.	*Production of Energy*	*Calories, Thiamin, Niacin, Riboflavin, Pantothenic Acid*
2.	*Synthesis of New Tissue*	*Protein, Folic Acid, Vitamin* B_{12}, B_6
3.	*Formation of Hemoglobin*	*Iron, Folic Acid, Vitamin* B_{12} *Protein*
4.	*Skeletal Growth and Development*	*Calcium, Phosphorus, Vitamin D*
5.	*Maintenance of Structure and Function of Cells*	*Vitamin A, Vitamin C, Vitamin E*
6.	*Regulation of Chemical Reactions in the Body*	*Iodine, Zinc, Magnesium*
7.	*Transportation of Nutrients and Metabolites throughout the Body*	*Water*

Recommended Nutrient Intakes have been established for the above nutrients. They exceed the requirements of almost all healthy individuals but should not be regarded as satisfactory for individuals recovering from nutrient depletion or for those with diseases that interfere with absorption, utilization or excretion of nutrients.

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ENERGY AND NUTRIENT REQUIREMENTS

Nutrition as a science is in its infancy. Many questions remain unanswered, especially questions about the energy and nutrient requirements of individuals. Canadian nutritionists, using the scientific information available together with their best judgement, have developed a Recommended Daily Nutrient Intake (RNI) table. Since 1938 there have been five revisions of the original recommendation (1).

Table I is adapted from the latest revision of the RNI's published in 1983. It outlines the estimated energy and nutrient requirements for non-pregnant and pregnant females (2). Canada's Food Guide and the Vegetarian Food Guide (Appendix B) are based on the RNI's. Food guides translate nutrient needs into food needs.

Use of the RNI's

So many factors affect nutrient requirements of a woman during pregnancy that a single figure in a table can be used only as a rough approximation of needs (3). The RNI is believed to exceed the requirement of almost all healthy individuals, but the estimates of requirements are not appropriate for persons recovering from previous depletion or undernutrition and they may not be appropriate for those with diseases that interfere with absorption, utilization or excretion of nutrients (2). For information on energy and protein recommended intakes for the nutritionally at risk client, refer to Appendix A.

TABLE 1

RECOMMENDED DAILY NUTRIENT INTAKES (1983) FOR NON PREGNANT AND PREGNANT WOMEN

Age/Years	Kilocalories per Kilogram[a]	Protein Grams per Kilogram IBW*	Vitamin A RE[b] per day	Vitamin D ug cholecalciferol[c] per day	Vitamin E mg[d] per day	Vitamin C mg per day	Folacin ug per day	Vitamin B_{12} ug per day	Thiamine mg per 1000 Kcal[e]	Riboflavin mg per 1000 Kcal	Niacin NE[f] per 1000 Kcal	Pyridoxine (B_6) mg per gram protein	Calcium mg per day	Magnesium mg per day	Iron mg per day	Iodine ug per day	Zinc mg per day
Non Pregnant																	
13–15	46	89	800	2 5	7	45	160	1 5	4	5	7 2	015	800	190	13	160	8
16 18	40	81	800	2 5	7	45	160	1 9	4	5	7 2	015	700	220	14	160	8
19–24	36	74	800	2 5	7	45	165	2 0	4	5	7 2	015	700	190	14	160	8
25–49	32	74	800	2 5	6	45	165	2 0	4	5	7 2	015	700	190	14	160	8
Pregnant[g]																	
									mg per 1000 Kcal	mg per 1000 Kcal	NE per 1000 Kcal	mg per gram protein					
1st trimester	+100 Kcal	+15 g	+100 RE	+2 5 ug	+2 mg	+0 mg	+306 ug	+1 ug	4	5+ 30 mg/day	7 2	015	+500 mg	+15 mg	+6 mg	+25 ug	+0 mg
2nd trimester	+300 Kcal	+20 g	+100 RE	+2 5 ug	+2 mg	+20 mg	+305 ug	+1 ug	4	5+ 30 mg/day	7 2	015	+500 mg	+20 mg	+6 mg	+25 ug	+1 mg
3rd trimester	+300 Kcal	+25 g	+100 RE	+2 5 ug	+2 mg	+20 mg	+305 ug	+1 ug	4	5+ 30mg/day	7 2	015	+500 mg	+25 mg	+6 mg	+25 ug	+2 mg

* Ideal Body Weight

[a] These figures are averages. Actual requirement varies within a range of ± 30% of these figures. Energy intake during pregnancy must not be lower than 36–40 kcal/kg for maximum nitrogen retention. 1 kilocalorie (calorie)= 4 18 kilojoules.

[b] 1 RE (retinol equivalent) corresponds to 1 ug retinol, 6 ug B-carotene or 12 ug of other carotenes. In a mixed diet of plant and animal sources, multiply RE value by 5 to convert to I U.'s

[c] 1 ug cholecalciferol is equivalent to 1 ug ergocalciferol (40 I U vitamin D) 5 ug cholecalciferol = 200 I U

[d] To approximate the number of I U.s, multiply the number of milligrams of vitamin E by 1 49.

[e] Intake for those 19 years and over should not be less than 8 mg/day

[f] 1 NE (niacin equivalent) is equal to 1 mg of niacin or 60 mg of tryptophan.

[g] Note for thiamin, riboflavin, niacin and pyridoxine, recommended intakes are expressed in relation to calorie or protein intake

NUTRIENT FUNCTIONS AND FOOD SOURCES

Table II outlines the rationale for increased needs for groups of nutrients as they relate to the metabolic processes of pregnancy (4-7). Examples of food sources of nutrients are listed in Appendix C.

The seven metabolic processes which serve as a framework for defining nutrient needs in pregnancy are: -

- Production of Energy
- Synthesis of New Tissue
- Formation of Hemoglobin
- Skeletal Growth and Development
- Maintenance of Structure and Function of Cells
- Regulation of Chemical Processes in the Body
- Transportation of Nutrients and Metabolites throughout the body.

TABLE II

NUTRIENTS REQUIRED FOR SEVEN METABOLIC PROCESSES OF PREGNANCY - RATIONALE FOR INCREASE

Metabolic Processes and Nutrients Required		Rationale for Increase
I	Production of Energy	
	Calories	Increased energy is needed for:- development of fetal, placental and maternal tissue increased maternal metabolism to maintain new tissue developed energy required to move a heavier body.
	Thiamin (B-1) Riboflavin (B-2) Niacin (B-3) Pantothenic Acid	These B vitamins do not yield energy in themselves but are all involved in the chemical reactions that produce energy in the body. When energy needs increase, the the requirements for these vitamins increase.

Metabolic Processes and Nutrients Required	Rationale for Increase
II. **Synthesis of New Tissue**	
Protein	Protein forms the structural basis for all new cells and tissues in the mother (expanded blood volume, uterus and breasts) and in the fetus.
Folic Acid	Folic acid is involved in almost all aspects of DNA and RNA synthesis - if it is lacking, cell division cannot proceed normally.
Vitamin B_{12} (cobalamin)	Vitamin B_{12} interacts with folic acid in the process of cell division.
Vitamin B_6 (pyridoxine)	Vitamin B_6 increases because protein and niacin needs increase. B_6 is involved in amino acid metabolism and in the conversion of tryptophan to niacin.

Metabolic Processes and Nutrients Required	Rationale for Increase
III. **Formation of Hemoglobin**	
Iron	Hemoglobin is an oxygen-carrying compound of four polypeptide chains, each composed of several hundred amino acids. Iron is a chief component of hemoglobin. The increased hemoglobin is found in maternal and fetal red blood cells.
Folic acid, vitamin B_{12}, protein and other vitamins and minerals are also involved in the production of red blood cells.	
IV. **Skeletal Growth and Development**	
Calcium	Calcium and phosphorus form the primary structural component of fetal skeleton and teeth.
Phosphorus	
Vitamin D	Vitamin D facilitates calcium and phosphorus absorption.

Metabolic Processes and Nutrients Required	Rationale for Increase
V. Maintenance of Structure and Function of Cells	
Vitamin A	Vitamin A keeps the body linings moist and healthy. These epithelial tissues include the skin, and membranes which line the glandless ducts and passages of the gastrointestinal, urinary and respiratory tracts. Bone cells are increased by an active form of vitamin A.
Vitamin C (ascorbic acid)	Vitamin C functions in reactions that oxidize proline, a non-essential amino acid, to hydroxproline, which is used to form collagen in connective tissue, skin, tendons and bones.
Vitamin E	The principal function of vitamin E is to prevent the oxidation of polyunsaturated fatty acids, which make up the structure of cell membranes. Vitamin E also prevents the oxidation of vitamin A in the gastrointestinal tract so that more vitamin A can be absorbed.

Metabolic Processes and Nutrients Required	Rationale for Increase
VI. Regulation of Chemical Reactions in the Body Hormones and enzymes maintain proper balance of body functions; they require minerals in order to do their work.	
Iodine	Iodine is necessary for normal functioning of thyroid hormone which regulates basal metabolism.
Zinc	Zinc is involved in the synthesis of DNA and RNA which makes it a highly important element in reproduction.
	Zinc is a component of insulin which regulates carbohydrate metabolism.
	Zinc is also part of the carbonic anhydrase enzyme system which helps maintain acid-base balance in the tissues.
Magnesium	Magnesium plays an intricate role in most cell functions; for example, it is involved in calcium homeostasis through a role in release and function of the parathyroid hormone, and it is involved in the replication of DNA and the synthesis of RNA.

Metabolic Processes and Nutrients Required	Rationale for Increase
Many other mineral elements are necessary for human reproduction, growth and general health. Like the minerals above, they participate in reactions that control body processes. Canadian nutritionists have not yet established recommended intakes for these minerals because there is limited knowledge of human requirements: Chromium Copper Cobalt Fluoride Manganese Molybdenum Nickel Selenium Silicon Vanadium Tin	

Metabolic Processes and Nutrients Required	Rationale for Increase
VII. Transportation of nutrients and Metabolites throughout the Body	
Water - Estimated Requirments: 1 litre for every 1000 calories of food intake in a temperate climate; increases up to several litres in hot weather. Fluid lost in sweat during physical exercise requires additional compensation.	Water, an essential nutrient, serves as the vehicle of transport for nutrients and their metabolites throughout the body. As food intake increases, water requirements increase. Water is a participant in all metabolic reactions. It regulates body temperature and it carries waste products of metabolism from the cells to the lungs, skin and kidneys to be excreted.
	Water is an important component of weight gained in pregnancy. The average amount gained in amnionic fluid, increase in blood volume and increase in tisue fluids is 3.6 kilograms (7 pounds, 14 ounces).

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CHAPTER VI

VITAMIN AND MINERAL SUPPLEMENTATION

GUIDELINES AND SUMMARY

It is recommended that food sources of nutrients be promoted and that vitamin and/or mineral supplementation be used only when there is a clear and specific clinical indication of need. Current information on nutrient content of commonly used prenatal supplements is included.

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TO SUPPLEMENT OR NOT

Food sources of nutrients (see Appendix C) should be promoted and vitamin-mineral supplementation should be used only when necessary. The rationale to support this position follows.

1. Many women are receptive to improving their food intake in pregnancy. When a woman improves her own diet, it is likely that the family's diet will improve as well. Promoting food sources of nutrients has the potential for a much longer-term impact on health than supplementation with vitamin-mineral supplements for the short term.

2. Vitamin-mineral supplements do not guarantee adequate nutrition and may give the user a false sense of security. Most supplements do not provide trace elements; nor do supplements provide protein and energy.

3. If there is an imbalance in the diet, that imbalance should be corrected with food whenever possible. Attempting to correct an imbalance with supplements can lead to further imbalance. A supplement of zinc, for example, may create a copper deficiency (1). The long term effects of zinc supplementation are unknown.

4. The proportions of nutrients in supplements are often inappropriate; for example, supplements usually contain more iron than zinc. This higher ratio inhibits zinc absorption because iron and zinc in supplements compete to be absorbed (2).

5. Certain vitamins in excess are toxic (Refer to the section on "Excessive Intakes of Vitamins and Minerals" in Chapter I).

6. Routine supplementation with multivitamin-mineral supplements is economically wasteful (3).

7. It is not yet known how well nutrients are absorbed from supplements.

8. A significant percentage of pregnant women do not take supplements as prescribed (3).

In some cases, supplementation may be indicated:

Iron

If low iron stores are suspected (from heavy menstrual flow, blood loss fron IUD, closely spaced pregnancies, poor diet, etc.) a thorough evaluation of iron status is recommended (4). Both nutrition counselling and supplementation with iron may be necessary.

Routine iron supplementation in pregnancy is being questioned in the literature, primarily because there is no evidence that the normal pregnant woman is at any advantage if she takes extra iron (4,5). Hytten and Chamberlain state that supplementation with any nutrient should be done only if there is a clear and specific clinical indication of need (4). They also point out that it is important to consider maternal hemodilution in relation to hemoglobin concentration (4).

5

It was recently reported that the amount of iron absorbed from many prenatal multivitamin-mineral supplements is significantly less than when the same amount of iron is ingested alone (6). Iron supplements may cause gastrointestinal side effects such as indigestion and constipation (3).

Iron absorption is increased in pregnancy, possibly as much as 30% compared with the usual 10% absorption from the diet (7). It may be further enhanced by including meat, fish or poultry in the meal, or a source of vitamin C, by not drinking regular tea or coffee with the meal, and by cooking in an iron pan (8,9).

Folate

If a folate deficiency is diagnosed, as perhaps after long term oral contraceptive use, a supplement is recommended in conjunction with nutrition counselling.

Folate supplementation should also be considered for those with multiple pregnancies, malabsorption syndromes, chronic hemolytic anemia and for those taking anticonvulsant drugs such as diphenylhydantoin (10).

In a differential diagnosis of megaloblastic anemia, B_{12} deficiency, although rare, must be considered (10). Mothers who have followed a strict vegetarian diet may have a severe deficiency which will be aggravated by breast-feeding. It is correctable by oral therapy for the mother or the infant (11).

Pyridoxine

Pyridoxine (B_6) laboratory levels are lower in pregnancy than in the non-pregnant state. Whether this is physiologically normal, or whether it should be corrected with supplements has not been established. Special attention to B_6 intake is needed if the woman has taken oral contraceptives and has not allowed sufficient time for normalization of B_6 metabolism before conceiving (12).

Calcium and Vitamin D

If an entire group of foods is omitted, perhaps as a result of food allergies, alternate food sources of the nutrients in that group should be emphasized. For example, if no dairy products are eaten, alternate sources of calcium and vitamin D, and also of protein and B vitamins must be selected. As a last resort only, a calcium supplement should be recommended (12). It is important to check the calcium content of the supplement to assure adequate intake. If fluid cow's milk is not included in the diet, vitamin D supplement should be recommended (12).

Zinc

Serum zinc levels in pregnant women have been found to be 20% lower than in non-pregnant controls despite supplementation of both groups to a level of 20 mg/day (13). The dilutional changes of nutrient levels in pregnancy make it difficult to diagnose deficiencies (10). Zinc plays a crucial role in reproduction; therefore, food sources of zinc must be emphasized in counselling women in the childbearing years. Zinc and protein intakes are highly correlated. Women with protein deficient diets may need zinc supplementation (14). Nutrition counselling to increase protein and zinc intake is also recommended.

Supplements Available

For reference, the nutrient content of vitamin-mineral supplements commonly used is shown in the following table (1983 data). Amounts listed are for the manufacturers recommended daily dose of the supplement. Information was obtained from the manufacturers and from the 1983 Compendium of Pharmaceutical Supplies (CPS). All supplements should be kept out of children's reach.

NUTRIENT CONTENT OF SELECTED VITAMIN –MINERAL SUPPLEMENTS

VITAMIN MINERAL SUPPLEMENT & MANUFACTURER	ELEMENTAL IRON* mg & SOURCE	FOLIC ACID ug	VITAMIN A I.U.	THIAMIN mg	RIBO-FLAVIN mg	NIACIN mg	VITAMIN B_6 mg	VITAMIN B_{12} ug	PANTOTHENIC ACID mg	VITAMIN C mg	VITAMIN D I.U.	VITAMIN E I.U.	CALCIUM mg	FLUORIDE mg	IODINE mg	COPPER mg	ZINC mg
ADELFLOR (UPJOHN)	30 FERROUS FUMARATE	400	6000	1.2	2.5	20	10	2	9.2	100	400		250	.4			
BEMINAL (AYERST)				4.5	3	15	1			150							
BEMINAL 500 (AYERST)				25	12.5	100	10		18.4	500							
FERGON (WINTHROP)	34.8 FERROUS GLUCONATE																
FERO-FOLIC 500 FILMTAB (ABBOTT)	105 FERROUS SULFATE	350								500							
LATAN (AYERST)	65.75 FERROUS FUMARATE	2000	5000	3	3	20	3	2		100	400		250				
MATERNA (LEDERLE)	60 FERROUS FUMARATE	1000	8000	3	3.4	20	4	12		100	400	30	250		.3	2	25
NATABEC (PARKE–DAVIS)	65 FERROUS SULFATE		4000	3	2	10	3	5		50	400		200				
NATABEC -F.A. (PARKE -DAVIS)	65 FERROUS SULFATE	100	4000	3	2	10	3	5		50	400		500				
NEUTRALITE DAILIES (AMWAY)	15 FERROUS FUMARATE	100	5000	2.3	2.6	20	2	9	11.1	90	400	25	200			2	
NORILAC (NORDIC)	66.7 FERROUS FUMARATE		6000	3	3		3			75	400		160				
ORIFER (DOW)	60 FERROUS SULFATE		1600	.75	1	6				50	200		134				
ORIFER -F (DOW)	60 FERROUS SULFATE	5000	1600	.75	1	6				50	200		134				
PALAFER (BEECHAM)	100 FERROUS FUMARATE																
PALAFER CF (BEECHAM)	100 FERROUS FUMARATE	500								200							
PARAMETTES (AYERST)	4 FERROUS SULFATE		10,000	3	5	25	1	3		150	400						
PARAMETTES FORTE (AYERST)	4 FERROUS SULFATE		10,000	10	10	50	2	6		250	1000						
PRENAVITE (A & H)	50 FERROUS FUMARATE	2500	4000							100	400		125				
PRENAVITE FORTE (A & H)	75 FERROUS FUMARATE	2500	4000								400		75				
SLOW FE (CIBA)	50 FERROUS SULFATE SLOW RELEASE																
SLOW FE FOLIC (CIBA)	50 FERROUS SULFATE	400															
TUTAMATE (FROSST)	75 FERROUS FUMARATE		5000	2	2	10	3			75	400						
TUTAMATE B–F (FROSST)	75 FERROUS FUMARATE	500	5000	2	2	10	3	5		75	400						
VITA A LEE (SHAKLEE)	14.5 FERROUS GLUCONATE	100	5000	2.1	2.4	20	2	9	10	90	400	25	632			2	

*PERCENTAGE ELEMENTAL IRON AVAILABLE IN CAPSULE FROM FERROUS FUMARATE - 33%, FERROUS SULFATE - 20%, FERROUS GLUCONATE = 12%

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CHAPTER VII

VEGETARIANISM AND PREGNANCY

GUIDELINES AND SUMMARY

Vegetarianism is becoming increasingly recognized as a dietary pattern which promotes health and reduces the risk of disease.

A well-planned vegetarian diet should be no cause for concern. A diet which is haphazardly planned (a simple substitution of vegetables for meat, for example) could lead to nutrient deficiencies.

Adequate caloric intake must be monitored during periods of rapid growth, such as pregnancy. Checks on the quality and quantity of food and an weight gain are recommended.

A food guide for vegetarians may be found in Appendix B.

It is important to check for protein complementarity especially during periods of growth. Plant proteins can be complemented by animal protein such as cheese, milk or egg. Plant proteins may complement each other, for example, seeds with legumes or grains with legumes.

Vegetarian diets should be assessed for sources of vitamin B_{12}, vitamin D, calcium and iron.

Strict vegan diets can be low in riboflavin, vitamin B_{12}, vitamin D, zinc, iron and calcium.

A food guide for vegans may be found in "Laurel's Kitchen" by Laurel Robertson et al..

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TYPES OF VEGETARIANISM

Vegetarianism embraces a variety of dietary patterns.

Lacto-ovo-vegetarianism: meat, fish, poultry are avoided; milk products eggs and plant foods are consumed

Lacto-vegetarianism: plant foods and dairy products are consumed

Veganism: plant foods are consumed; nuts, seeds, grains, vegetables, fruit, soy milk

Modified vegetarianism: fish, poultry, dairy products, eggs and plant foods may be consumed

It is important to consider that most of the difficulties related to vegetarianism reported in the literature arise from limited vegan diets, or from radically limited vegetarian diets, or from vegetarian diets in third world countries, rather than from the traditional diets of groups of vegetarians in North America (1). A well-planned vegetarian diet should be no cause for concern. Vegetarianism is becoming increasingly recognized by many researchers as a dietary pattern which promotes health and reduces the risk of disease (2), and it is consistent with the Nutrition Recommendations for Canadians (3) and the U.S. Dietary Goals (4).

A vegetarian diet which is haphazard (a simple substitution of vegetables for meat, for example) could lead to nutrient deficiencies. Attention to diet planning is crucial.

Adequate caloric intake is a major concern during periods of rapid growth, such as pregnancy. A diet high in bulk, as a vegetarian diet may be, may not meet caloric needs. If a large percentage of total calories is from a high intake of fat, sugar and refined carbohydrates, the diet may not be adequate in protein. Checks on the quality and quantity of food, and monitoring of weight gain are important.

A food guide for the lacto-ovo vegetarian is outlined in Appendix B. A pamphlet entitled "Vegetarianism and Pregnancy" is available from the B.C. Ministry of Health through the local health unit office (5).

Strict vegan diets can easily be low in riboflavin, vitamin B_{12} vitamin D, zinc, iron and calcium (1). Close evaluation of dietary adequacy may be needed. A food guide for the vegan may be found in "Laurel's Kitchen" (6).

COMPLEMENTARY PROTEINS

With a well balanced diet and varied diet, adequate in calories, one should not be overly concerned about whether proteins complement each other at the same meal (2). It is important, however, to check for protein complementarity especially if the person is pregnant, lactating or growing; or if the total protein intake is lower than average; or if the person is eating fewer than three meals a day (2).

There are nine essential amino acids (EAA) that must come from dietary sources (the body can synthesize the other thirteen). All plant foods are deficient in one or more of the EAA. An EAA which is in short supply in a plant protein is called a limiting amino acid (it limits the building of body protein because it is not available in sufficient quantity).

When protein foods are combined, the EAA deficiency in one food can be met by the EAA contained in another food: they complement each other. For example, when brown rice and beans are eaten together the limiting amino acid, lysine, in the rice is provided by the beans; the limiting amino acid, methionine, in the beans is provided by the rice. Animal proteins (except gelatin) contain all the EAA. If animal protein such as cheese, milk or egg is eaten with plant protein, these proteins will complement each other.

Table II illustrates how protein foods may be combined to enhance their EAA content (2). Recipes are available in vegetarian cookbooks (2,6).

TABLE II

EXAMPLES OF COMPLEMENTARY PROTEINS

GRAINS PLUS LEGUMES	GRAINS PLUS MILK	SEEDS PLUS LEGUMES
rice-bean casserole	rice pudding and milk	middle Eastern homous (sesame and chick peas)
wheat-soy bread	macaroni and cheese	
lentil curry on rice	cheese sandwiches	sunflower seeds and peanuts
corn soy bread		
whole wheat bread and baked beans	barley and yoghurt soup	sesame seeds in bean soups and casseroles
bean curry on rice	cereal with milk	
corn tortillas and beans	pasta with milk or cheese	blended dip of ground toasted sesame seeds, tofu, lemon, oil, garlic
pea soup and toast	rice-cheese casserole	
lentil soup and bread	wheat berries with cheese sauce	roasted seeds and soybean snack

VEGETARIAN FOOD SELECTION

Guidelines for counselling clients to eat a high quality vegetarian diet during pregnancy are listed by food group in the following page.

Milk and Milk Products

1. Foods from this food group are significant sources of:

Protein	Vitamin B_{12}
	Calcium
Riboflavin	Vitamin D

2. Four daily servings of dairy products are recommended. If soybean milk is used, Vitamin B_{12} and calcium should be added. For each six cup quantity of soybean milk, add 1800 milligrams (3 teaspoons or 15 milliliters) of calcium carbonate and one 25-50 microgram tablet (crushed between two spoons) of Vitamin B_{12}(6). It is important to shake the milk before serving it because the calcium carbonate does not easily dissolve. If soy milk is used solely, and Vitamin D has not been added to it, a daily supplement of 200 I.U.s (5ug cholecalciferol) is recommended.

   A method of making soy milk has been developed at Cornell University and is described in "Laurel's Kitchen" (6). The authors say it is superior in taste and less expensive than commercial or powdered soy milk.

3. The nutrients provided by the milk and milk products food group may be obtained to some extent from other foods; for example, broccoli, soybeans, some nuts, salmon, sardines and tofu (soybean curd) are good sources of calcium. See Appendix C for a detailed listing of food sources of calcium.

4. Milk is an important source of Vitamin B_{12}. If milk, or soy milk fortified with B_{12}, is not used an alternate source of B_{12} may be needed. Foods such as soy sauce, miso, tempeh, seaweeds and algae may contain some B_{12}, but values vary and may not be adequate (7).

B_{12} supplements are available in doses not less than 25 micrograms, so one tablet per week is believed to be sufficient. Vitamin B_{12} supplements do not violate a vegetarian diet because they are made from a bacterial source (6).

5. British Columbia dairies are required to add Vitamin D to all fluid milk, but not to milk that is used for milk products such as cheese and yoghurt. If the expectant vegetarian is using unfortified dairy products, or no dairy products at all, a Vitamin D supplement of 200 I.U. is recommended. Dairies producing goat's milk are not required to add vitamin D.

6. If raw milk is used, home pasteurization is recommended to eliminate the risk of milk-borne disease (8). Instructions for home pasteurization of milk are available from the Nutrition Division, British Columbia Ministry of Health or from the local health unit office. A Vitamin D supplement is recommended.

Whole Grain Breads and Cereals
And
Legumes, Nuts, Seeds and Eggs

1. Foods from these two groups are significant sources of:

Protein	Vitamin E
Thiamin	Iron
Niacin	Zinc
Vitamin B_6	Magnesium
Fibre	Folic Acid

2. Selection of iron rich foods from these groups will lower one's risk of iron deficiency and will provide iron stores for the baby. For sources of iron, refer to Appendix C.

3. These groups are good sources of incomplete protein; they should be chosen in combinations to provide all the essential amino acids. Refer to Table II of this chapter for suitable combinations.

Fruits and Vegetables

1. This food group provides:

Vitamin A	Vitamin C
Folic Acid	Calcium
Riboflavin	

2. Fruits and vegetables are highly regarded for their nutritive value but should not be consumed in large quantities at the expense of other food groups which provide needed nutrients.

3. Eating foods from this group, raw or very lightly cooked, helps conserve nutrients such as folic acid and Vitamin C. A food source of Vitamin C at each meal will increase the absorption of dietary iron. Homemade and some commercially available apple juices are not good sources of Vitamin C unless powdered Vitamin C has been added. Ascorbic acid is available in a highly concentrated crystal form. Adding 600 milligrams of Vitamin C to a litre of apple juice would make it approximately equivalent to orange juice in Vitamin C content.

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CHAPTER VIII

FOOD PLANNING DURING PREGNANCY

GUIDELINES AND SUMMARY

Ten steps in food planning for the pregnant woman are presented in a format which may be used by the health professional as a guideline for counselling.

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TEN STEPS IN FOOD PLANNING DURING PREGNANCY

Step 1

If a nutrition assessment reveals any of the factors in Table 1, Chapter III, entitled "Conditions Which May Signal the Need for Intensive Nutrition Counselling", referral to an outpatient dietitian/nutritionist may be indicated. The dietitian/nutritionist will take a diet history and assess the client's medical, socioeconomic and occupational background. A dietary prescription will be calculated based on the individual's requirements. Guidance will be given about modifications to the client's usual food intake pattern. Follow-up counselling will be arranged as required.

If none of the "nutritional risk" conditions are present, proceed to Step 2.

Step 2

Select at least the following numbers of servings from these four food categories as outlined in Canada's Food Guide:

Milk and Milk Products	4 servings
Breads and Cereals	5 servings
Fruits and Vegetables	5 servings
Meats, Fish Poultry and Alternates	2 servings

These foods provide a nutritional foundation and supply approximately 1400 calories. Additional servings are needed to meet energy needs.

Refer to "Canada's Food Guide" for serving size information. If vegetarian, refer to the Vegetarian Food Guide. Both are in Appendix B.

Record your food intake each day. See Appendix B for sample food record form. Compare your food record with the Food Guide.

Information on characteristic food choices for some ethnic groups in B.C. is in Appendix E (1).

Step 3

The quantity of food (calories) needed depends on your height, weight and activity level. Additional needs for pregnancy for the normal weight, well nourished woman are 100 kilocalories in the first trimester and 300 kilocalories in the second and third trimesters.* Increasing the number of servings from each food group or increasing the size of servings will increase calories.

Appropriate weight gain is an important indicator of the adequacy of caloric intake.

Step 4

To improve the quality of your diet, choose nutrient dense foods from each group.

*1 kilocalorie = 4.18 kilojoules

Raw spinach in a salad or a sandwich instead of lettuce will provide over five times as much folic acid, over four times as much vitamin A, almost three times the vitamin C and over twice as much iron (2,3).

Whole grains compared to refined grains provide more vitamin E, folate, magnesium, zinc, iron, other trace elements and fiber.

Examples of whole grains are: 100% whole wheat bread and flour, whole wheat pastas (spaghetti, lasagna, macaroni), buckwheat, bulgar wheat, cornmeal, millet, brown rice, whole barley. These products may be available either at the supermarket or at health food stores.

Plain yoghurt is more nutritious than sweetened varieties.

Refer to Appendix C for information on foods rich in folic acid, vitamin B_6, iron, calcium and zinc which have been found to be low in pregnant women's diets.

For further information, a booklet, "Nutrient Values of Some Common Foods", published by Health and Welfare Canada, is available from B.C. health units (3).

Step 5

Include liver in your diet occasionally to provide generous amounts of nutrients, particularly iron and folic acid.

> 3 ounces of chicken liver supply approximately
> 8 milligrams iron and 180 ug of folic acid

Step 6

Eat some raw food daily. Nutrients are lost when food is cooked. Fruits and vegetables eaten as snacks, desserts or as salads are recommended.

Step 7

Salt should not be restricted. A reasonable intake of sodium is desirable.

Step 8

Drink 6 - 8 glasses of fluids, including water, each day. Avoid alcoholic beverages.

Step 9

If sweets and desserts are liked, select those which supply nutrients and are not too high in added sugar, salt or fat. Some examples are:

- milk puddings, bread puddings, rice puddings
- fresh fruit salad
- apple crisp
- carrot cake
- banana bread
- date or peanut butter cookies
- oatmeal and raisin cookies
- yoghurt and berries

Step 10

A woman should be counselled to think of pregnancy as a time to improve her relationship with food. Many women find that their first pregnancy is the beginning of more health promoting habits. Some questions a woman might ask herself are listed on the following page (5).

1. Am I satisfied with my present level of health and nutrition?
2. Are there any changes I want to make in the way that:
    - I grow or buy food?
    - I plan meals and snacks?
    - I store or cook food?
    - I eat food?
3. How do I feel before, during and after I eat/drink certain foods/beverages?
   (Consider bowel function, sense of taste, energy level, mood.)

For cookbook recommendations, see references #6 and #7.

For detailed information on food planning during pregnancy, a pamphlet and poster entitled "Best Beginnings for Your Baby" are available from health units in B.C. to health professionals and to expectant parents.

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CHAPTER IX

SOME CONCERNS DURING PREGNANCY

GUIDELINES AND SUMMARY

Nutritional guidance is helpful for some concerns that may develop during pregnancy, such as nausea and vomiting, heartburn, constipation, flatulence, edema, leg cramps, migraine headaches and food cravings and aversions. General food-related guidelines that apply to the first four of these concerns, are that the woman should:

- *maintain a healthful, varied diet, adequate in food sources of protein and complex carbohydrates*
- *avoid excess intake of fatty and fried foods*
- *limit sweet food choices*
- *drink 6-8 glasses of water each day*
- *have several, regular, small meals and snacks each day, starting before rising in the morning when there is nausea.*

-###-

NAUSEA AND VOMITING

Many women experience varying degrees of nausea and vomiting usually in the first trimester, but sometimes throughout pregnancy. It may occur at any time during the day. Its etiology is still unknown. Contrary to popular theory, recent studies have not shown a relationship between the levels of specific hormones, including human chorionic gonadotropin and 17-hydroxyprogesterone, and the incidence or severity of nausea and vomiting in pregnancy (1). An emerging theory suggests a psychosomatic component, with psychiatric studies focusing on women with hyperemesis gravidarum (excessive, persistent vomiting any time in pregnancy) (2). It has also been suggested that nausea may have a protective effect by eliminating embryotoxic substances (3).

Mild cases of nausea and vomiting may be relieved by making modifications to the diet. Suggestions include:

- crackers or dry toast as a snack before getting out of bed and getting out of bed slowly
- a high protein snack in the evening
- a cup of clear weak tea or a small glass of apple juice, ginger ale, or a mild herbal tea such as ginger or mint (4) to soothe the nausea
- small amounts of food every one or two hours
- fluids consumed only between meals, not with meals
- sources of B vitamins in the diet (see Appendix C)
- limited fatty and fried foods
- milk in coffee and limited overall coffee consumption
- diet restricted to easily tolerated foods for a few days until the nausea is under control
- clear, hard candies, especially before getting out of bed
- a well-balanced diet, even though some foods may be avoided.

Additional suggestions for the woman with nausea include:

- avoidance of tight waistbands and underwear
- as much rest as possible
- minimal emotional stress - maximum emotional support
- stress reduction techniques such as yoga, relaxation and autogenic exercises such as biofeedback, visualization
- fresh air in the bedroom while resting
- cold meals instead of hot to avoid nausea triggered by food odours
- fresh air in the kitchen while cooking.

There has been some success with the use of B complex vitamins in controlling nausea (5). The success is experiential only, and is not well documented in the scientific literature.

The Montreal Diet Dispensary reports success in having mothers with severe vomiting "baby themselves" for a few days (6). This might mean: going to bed; resting; eating quietly and away from the family; eating frequent small meals of pureed and soft foods; being given extra care by family members such as bringing snacks, rubbing her head or massaging her feet with oil or lotion.

Women with uncontrolled hyperemesis gravidarum may require hospitalization to prevent dehydration and achieve fluid and electrolyte balance.

HEARTBURN

Heartburn due to reflux (food, acid or bile pushed back into the lower part of the esophagus) is most commonly present in the second and third trimesters. It is attributed to pressure of the enlarging uterus crowding the stomach, or to a weakness in the lower esophogeal sphincter due to hormonal changes (7,8).

Practical experience has shown that the following suggestions may help prevent or relieve heartburn during pregnancy:

- avoiding spicy, fried and fatty foods, caffeine and alcohol
- eating frequent small meals
- eating slowly
- drinking fluids between, rather than with, meals
- avoiding bending or lying down flat, particularly for one or two hours after eating
- elevating head and shoulders while resting
- eating a mildly acidic food such as yoghurt or buttermilk (9)
- using an antacid as a last resort (after the first trimester); if the heartburn is worse at night, the antacid should be taken at least one-half hour before going to bed (10).

The more commonly used antacids contain magnesium and aluminum hydroxides. These elevate the stomach alkaline pH level and interfere with iron absorption. They should not be consumed at the same time as iron supplements. Small doses of aluminum-containing antacids and a high intake of calcium may prevent the increased bone resorption of calcium previously associated with large doses of these antacids (10).

Baking soda should not be used due to its high sodium content. It can also interfere with the body's acid-base balance, and can destroy thiamin (11).

CONSTIPATION

Constipation often occurs in the second half of pregnancy for two major physiological reasons:

- the hypomotility of the stomach and intestinal smooth muscle delays the passage of food and allows increased absorption of nutrients

- the pressure of the uterus from the larger fetus impairs the peristaltic motion of the intestine, interfering with food passage.

Iron supplements may also contribute to constipation.

Modifications to diet to help prevent constipation are:

- increased fluid intake: 6-8 glasses of water per day or a glass every two hours; a glass of warm water before breakfast may help, or a small amount of prune juice
- increased amounts of high fibre foods in the diet, for example, whole grain breads and cereals, bran, fresh fruit and vegetables, dried fruits (especially prunes and figs)
- regular eating times
- limited regular coffee and tea intake; they have a diuretic effect.

Other suggestions also appropriate are:

- regular toilet habits, unrushed, at a time when the demands of children and the household or workplace do not interfere; this may require some reorganization of the daily routine
- immediate response to the need for a bowel movement
- regular moderate exercise
- if a laxative is needed occasionally, a bulk-producing or a perastaltic stimulant is preferred (12,13).

FLATULENCE

During pregnancy, the slow movement of food through the stomach allows gas-forming bacteria more time to break down undigested starches and sugars. Use of high sugar foods such as candy, soft drinks and sweet desserts should be limited. Specific foods may aggravate flatulence for some women and they should be avoided when identified. Mint tea may provide relief for some women (4). Flatulence may occur temporarily if legumes such as beans and lentils are introduced into the diet, but usually it does not last.

EDEMA

Edema, if not accompanied by hypertension and proteinuria, is a normal physiologic response to pregnancy, associated with an increase of 50% in blood volume over the preconception level (14). Ankle swelling frequently occurs during pregnancy. Women can gain as much as nine litres of fluid (approximately 20 pounds) and still have clinically normal pregnancies (14). The accumulation of fluid should be gradual. However, a sudden increase in weight is an indication of preeclampsia which is discussed in Chapter III, page 86. Sodium restriction is not recommended in edemic patients. It compounds the problem by stressing the renin-angiotensin-aldosterone system, leading to hypertrophy and hyperplasia of the adrenals (15).

Proof of benefit from diuretic agents is lacking and risks associated with their use are many (16). For details, see the section on preeclampsia and eclampsia, Chapter III, page 86. The use of diuretics along with even a mildly restricted salt intake may have a serious impact on renin secretion by the kidney and on the structure and function of the adrenals (14).

Rest, with the feet elevated above the heart may alleviate edema of the lower extremities.

LEG CRAMPS

Pressure of the growing fetus and uterus on the nerves that reach to the women's lower extremities may cause leg cramps during late pregnancy, particularly at night. Other possible causes are fatigue, chilling, or tense body posture. Warmth, rest and elevation of the feet and legs several times a day may help prevent leg cramps.

Insufficient calcium or an imbalance of calcium and phosphorus may also be related to leg cramps. Several manipulations have been used to treat leg cramps including:

1. reduction of milk and milk products because they are high in phosphorus. The usefulness of this approach is questionable (14), and the reduction of these protein and calcium rich foods is a concern.
2. use of aluminum hydroxide gels. However, iron absorption is reduced in the presence of these gels (10).
3. use of an oral calcium supplement. In a non double blind study, an oral calcium preparation with calcium gluconate calcium lactate and calcium carbonate corresponding to one gram of calcium, twice daily, resulted in clinical improvement in 21 pregnant women with leg cramps (17). The duration of the study was two weeks.

The use of calcium supplements is controversial (18). A reasonable dietary suggestion for the prevention of leg cramps is to reduce foods low in calcium and high in phosphorus (carbonated beverages, refrigerated doughs, processed meats and commercially baked products) and to emphasize calcium containing foods (see Appendix C for a listing).

To help relieve a muscle cramp, the woman may press her foot against a firm surface or when lying down keep her leg straight and pull her toes toward her head.

MIGRAINE HEADACHES

Migraine affects roughly 8% of the general population. A woman susceptible to migraine headaches before pregnancy may continue to experience them while pregnant.

Some causes of migraine suggested in the literature are stress, hormonal changes, hypoglycemia and dietary factors. The causes are believed to be cumulative and an attack is more likely when more than one factor is operating (19).

Consumption of some foods may be related to the onset of some migraines. It is important to note foods eaten in the 24 hours before the attack and to exclude these foods for a trial period (19).

Tyramine, a monoamine, found in cheeses and red wine, may precipitate an attack. Other substances reported to play a role in migraine headaches are: chocolate, citrus fruits, coffee and food additives such as sodium nitrite, tartrazine (a yellow dye) and monosodium glutamate (M.S.G.) (19, 20).

FOOD CRAVINGS AND AVERSIONS

Some pregnant women experience a strong desire for and/or a strong distaste for specific foods. The reasons for food cravings or aversions are not well understood, but they seem to be universal. It has been suggested that cravings/aversions are the body's response to a need. It may be that the "wisdom of the body" is worth listening to, although there is no definitive evidence to support this claim. Unless these cravings or aversions threaten the nutritional status of the woman, they are no cause for concern (11).

In two studies of a total of 302 pregnant women, common cravings reported were for sweets, ice cream, milk and fruit. Aversions reported were to meats, strong-flavoured vegetables and spicy foods. Alcohol and coffee were also common aversions (21, 22).

If meats are limited, balanced combinations of vegetable proteins should be eaten. Some examples are listed in the "Vegetarianism and Pregnancy" section of this manual.

Pica is discussed in Chapter III, page 77.

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APPENDIX A

THE MONTREAL DIET DISPENSARY METHOD OF NUTRITION INTERVENTION DURING PREGNANCY

(FOR INTENSIVE ONE-TO-ONE COUNSELLING PROGRAMS)

The Montreal Diet Dispensary Method of nutrition intervention during pregnancy involves:

- establishing a trusting relationship with the pregnant woman. The dietitian/nutritionist often meets the client for the first visit in the client's own home. Successive appointments are held at the Diet Dispensary (in an older home setting).

- assessing the client's medical, socioeconomic and occupational background.

- taking a diet history and then to increase accuracy, cross-checking the information with a food list and typical shopping habits.

- comparing the diet history with the woman's normal pregnancy requirements, to which are added rehabilitative corrections based on her risk status.

- calculating a dietary prescription according to the time remaining in the pregnancy.

- instructing the client and relating any modifications in diet to her usual food intake pattern. No diet sheets are used. With simple analogies, graphics and motivation techniques, the caring counsellor involves the woman in planning her food intake to "feed the baby". Specific techniques are used to involve the family in supporting the mother.*

- counselling and supporting the client on a follow-up basis, usually every two weeks.

- providing the client with supplements (milk tickets, orange juice, eggs) when income is inadequate.

- providing a vitamin-mineral supplement if necessary.

The rehabilitative corrections used in the Montreal Diet Dispensary Method are briefly outlined below.

1. Undernutrition Correction

   If the woman's initial diet history reveals a protein deficit (intake is less than requirement) an undernutrition correction is added to her normal daily pregnancy requirements. The correction is equal to the number of grams of protein under requirement, allowing 10 kilocalories** per gram protein.

   Example:

   Protein requirement for Woman A (1st trimester) = 62 grams
   Protein intake at initial assessment = 52 grams
   Protein Deficit = 10 grams
   Kilocalorie allowance = 10 g x 10 kilocalories per gram = 100 kilocalories
   Correction = 10 grams protein plus 100 kilocalories
   Correction is added to daily pregnancy requirements.

2. Underweight Correction

   The underweight correction is added to normal daily pregnancy requirements, if a woman is 5% or more under ideal weight for height at conception. For each pound to be gained weekly (up to 2 pounds per week), 500 kilocalories and 20 grams of protein are added. The maximum correction for underweight is 1000 kilocalories and 40 grams protein. For fractions of a pound, calculate to the nearest half-pound.

* Detailed information on the art of counselling pregnant women is available from the Montreal Diet Dispensary, 2181 Lincoln Avenue, Montreal, Quebec, H3H 1J3.

** 1 kilocalorie = 4.18 kilojoules

Example: Woman B is 20 weeks pregnant. At conception she was 10 pounds under ideal weight for height.

Time remaining in pregnancy = 20 weeks
Number of pounds underweight = 10 pounds
Number of pounds per week to gain = 1/2 pound
Correction for 1/2 pound per week = 250 kilocalories and 10 grams protein.

3. Nutritional Stress

The correction allowance provides an addition of 200 kilocalories and 20 grams protein for each stress condition. The maximum correction for stress is 400 kilocalories and 40 grams protein.

The stress factors are:

- pernicious vomiting
- close pregnancies (less than one year apart)
- serious emotional problems (for example, death of husband)
- failure to gain 10 pounds by the 20th week (with the exception of the grossly overweight woman)
- poor obstetrical record in the previous pregnancy (abortion, history of LBW infant less than 2500 grams).

At the Montreal Diet Dispensary, the 1948 Canadian Dietary Standard for calories and protein is used to determine daily pregnancy requirements. The 1958 U.S. Recommended Dietary Allowance is used to determine daily pregnancy requirements for adolescents. It is recommended that these standards be used in counselling programs in B.C. for women who are undernourished, underweight or under stress as defined at the Montreal Diet Dispensary. It is also recommended that the rehabilitative corrective factors developed at the Montreal Diet Dispensary be used as a guideline in counselling nutritionally at risk women in B.C.

KILOCALORIE AND PROTEIN STANDARD USED AT MONTREAL DIET DISPENSARY (TEENS)

Age	Kilocalories	Protein
13 - 15	2600	85
16 - 19	2400	75

Additional Requirement for Pregnancy - 500 kilocalories
25 grams protein

KILOCALORIE AND PROTEIN STANDARD USED AT MONTREAL DIET DISPENSARY (NON-PREGNANT WOMEN)*

Body Weight Pounds	Body Weight Kilograms	Degree of Activity	Kcal.	Pro.	Body Weight Pounds	Body Weight Kilograms	Degree of Activity	Kcal.	Pro.
Female									
80	36	Sedentary	1600	40	125	57	Sedentary	2150	57
		Moderate	1900	40			Moderate	2450	57
		Heavy	2400	40			Heavy	2950	57
85	38.5	S	1650	43	130	59	S	2200	58
		M	1950	43			M	2500	58
		H	2450	43			H	3000	58
90	41	S	1700	45	135	61	S	2250	59
		M	2000	45			M	2550	59
		H	2500	45			H	3050	59
95	43	S	1750	47	140	63.5	S	2300	60
		M	2050	47			M	2600	60
		H	2550	47			H	3100	60
100	45.5	S	1800	50	145	66	S	2350	63
		M	2100	50			M	2650	63
		H	2600	50			H	3150	63
105	47.5	S	1875	52	150	68	S	2400	65
		M	2175	52			M	2700	65
		H	2675	52			H	3200	65
110	50	S	1950	53	155	70.5	S	2450	68
		M	2250	53			M	2750	68
		H	2750	53			H	3250	68
115	52	S	2025	54	160	72.5	S	2500	70
		M	2325	54			M	2800	70
		H	2825	54			H	3300	70
120	54.5	S	2100	55					
		M	2400	55					
		H	2900	55					

To use the table, calculate clients desirable weight for height, assess activity level and note the kilocalorie and protein need.

*Additional Requirement for Pregnancy = 500 kilocalories, 25 grams protein

Sedentary = office work or light housework

Moderate = housework or job which requires moving around

Heavy = very heavy physical activity, e.g., working with heavy equipment (few women in this category)

HOW TO USE THE DIET TRACKER

For one week:

1. Record what you eat daily in the appropriate food group column.
2. Each box or circle represents 1 serving from that food group. Check off each serving you have in a day. Examples of servings will be found in the Canada Food Guide.
3. Mark down any extra foods you eat (ie. snacks) in the appropriate column.
4. Be honest with yourself.
5. At the end of the week fill out the Fine Tuning section on this page. Refer to the accompanying chart for examples of sources of Vitamins and Minerals.
6. Compare your weekly diet with the Canada Food Guide recommendations.

	MILK AND MILK PRODUCTS	MEAT, FISH, POULTRY AND ALTERNATES	FRUITS AND VEGETABLES	BREADS AND CEREALS	EXTRAS
MONDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	
TUESDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	
WEDNESDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	
THURSDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	
FRIDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	
SATURDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	
SUNDAY	☐☐☐☐○○	☐☐○○	☐☐☐☐☐○○	☐☐☐☐☐○○	

[illegible]

	YES	NO
1. Do I drink 2 cups of milk daily to meet my need for Vitamin D?	☐	☐
2. Have I increased the fiber in my diet by:		
a) making most of my bread servings whole grain?	☐	☐
b) eating raw fruits and vegetables frequently?	☐	☐
3. Do I daily eat foods containing the following nutrients: (see food sources below)		
Iron	☐	☐
Vitamin B_6	☐	☐
Folate	☐	☐
Vitamin C	☐	☐
4. Do I drink water daily?	☐	☐
5. Do I watch my intake of:		
fat	☐	☐
caffeine	☐	☐
salt*	☐	☐
alcohol*	☐	☐

*If you are pregnant or planning to become pregnant, use salt to taste (in moderation) and do not drink alcoholic beverages.

[illegible]

IRON
- liver
- heart
- lean beef, pork
- dry peas, beans and lentils
- whole grain breads and cereals
- dried apricots, prunes, raisins
- nuts
- sesame and sunflower seeds

FOLATE
- whole grain breads and cereals
- sunflower seeds
- fish, poultry
- liver
- dried beans
- brewer's yeast
- nuts
- bananas

VITAMIN B_6
- liver
- kidney
- wheat germ, whole wheat bread
- brewer's yeast
- broccoli, dark greens (spinach)
- orange juice
- garbanzo beans
- peanuts

VITAMIN C
- oranges and orange juice
- vitaminized apple juice
- broccoli (raw or lightly cooked)
- raw cabbage, raw turnip
- tomato and tomato juice
- baked potato
- canteloupe
- raw green pepper

COMPUTER PROGRAMS

Programs for assessing nutrient intake by computer are available. For further information, contact your health unit nutritionist. If there is no health unit nutritionist available, contact the Nutrition Division, B.C. Ministry of Health, Victoria.

A computer analysis is available for all those in B.C. from the Y.M.C.A.

Contact:

Computerized Nutrition Analysis
c/o Downtown Y.M.C.A.
955 Burrard Street
Vancouver, B.C.
V6Z 1Y2
(604) 681-0221

1984 Prices

One Day Analysis = $7.75 plus postage
Three Day Analysis = $12.00 or delivery
Seven Day Analysis = $19.00

Write or phone and the necessary forms will be sent to you.

Canada's Food Guide

Eat a variety of foods from each group every day

milk and milk products

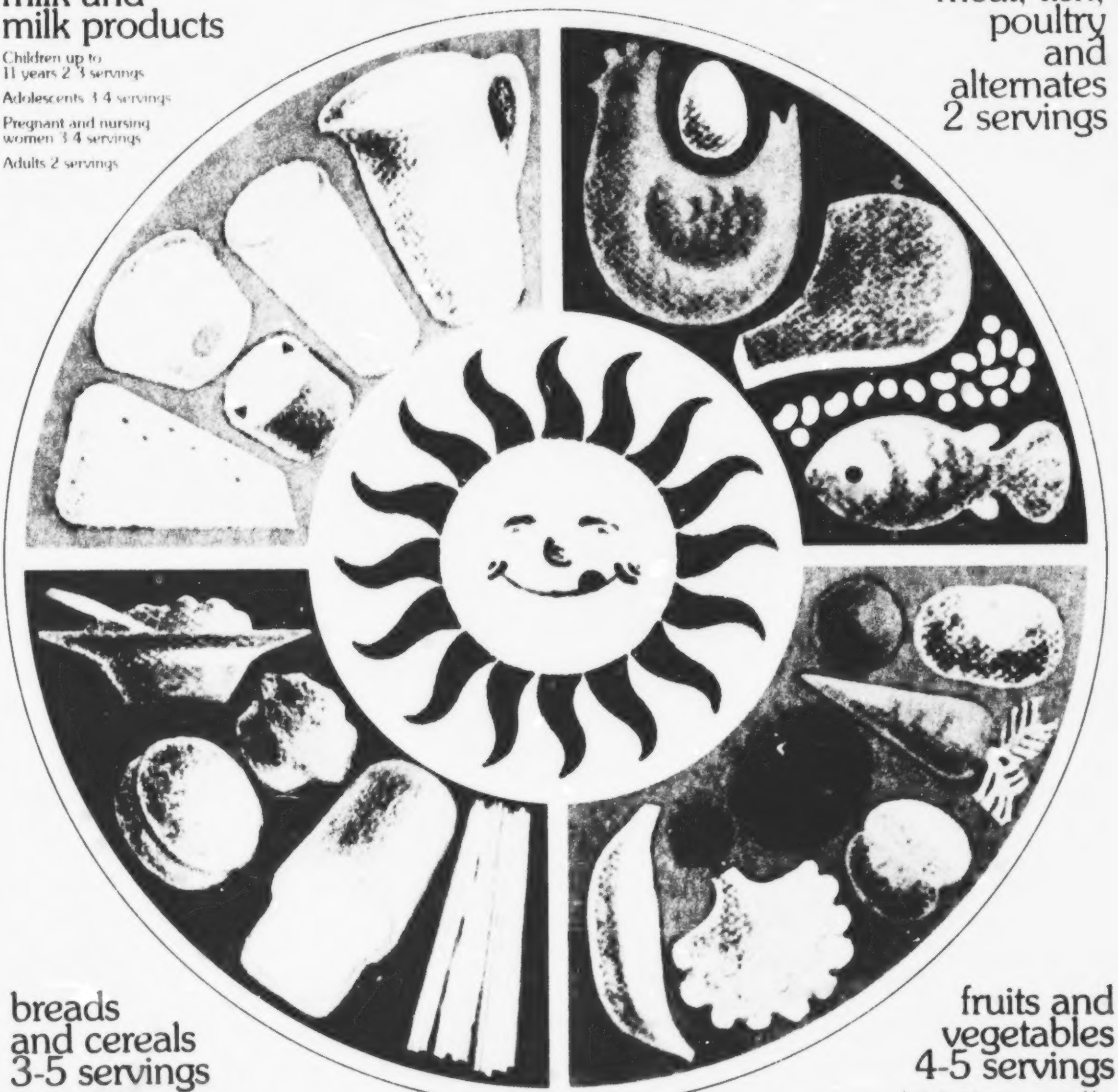
Children up to 11 years 2-3 servings

Adolescents 3-4 servings

Pregnant and nursing women 3-4 servings

Adults 2 servings

meat, fish, poultry and alternates 2 servings



breads and cereals 3-5 servings

whole grain or enriched

fruits and vegetables 4-5 servings

Include at least two vegetables

Health and Welfare Canada
Sante et Bien-être social Canada

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Canada

Canada's Food Guide

Variety

Choose different kinds of foods from within each group in appropriate numbers of servings and portion sizes.

Energy Balance

Needs vary with age, sex and activity. Balance energy intake from foods with energy output from physical activity to control weight. Foods selected according to the Guide can supply 4000 – 6000 kJ (kilojoules) (1000 – 1400 kilocalories). For additional energy, increase the number and size of servings from the various food groups and or add other foods.

Moderation

Select and prepare foods with limited amounts of fat, sugar and salt. If alcohol is consumed, use limited amounts.

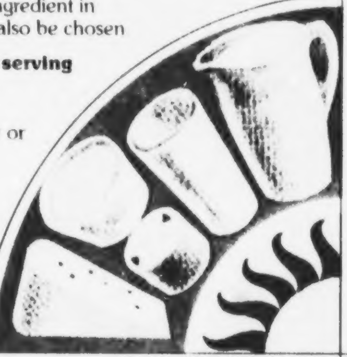
milk and milk products

Children up to 11 years	**2-3 servings**
Adolescents	**3-4 servings**
Pregnant and nursing women	**3-4 servings**
Adults	**2 servings**

Skim, 2%, whole, buttermilk, reconstituted dry or evaporated milk may be used as a beverage or as the main ingredient in other foods. Cheese may also be chosen.

Some examples of one serving
250 mL (1 cup) milk
175 mL (¾ cup) yoghurt
45 g (1½ ounces) cheddar or process cheese

In addition, a supplement of vitamin D is recommended when milk is consumed which does not contain added vitamin D.



meat, fish, poultry and alternates

2 servings

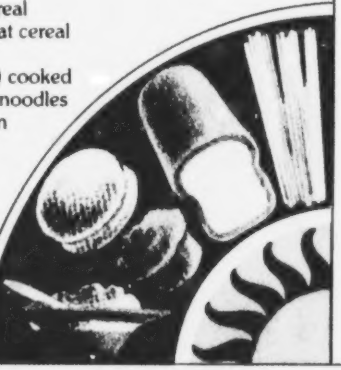
Some examples of one serving
60 to 90 g (2–3 ounces) cooked lean meat, fish, poultry or liver
60 mL (4 tablespoons) peanut butter
250 mL (1 cup) cooked dried peas, beans or lentils
125 mL (½ cup) nuts or seeds
60 g (2 ounces) cheddar cheese
125 mL (½ cup) cottage cheese
2 eggs

breads and cereals

3-5 servings

whole grain or enriched. Whole grain products are recommended.

Some examples of one serving
1 slice bread
125 mL (½ cup) cooked cereal
175 mL (¾ cup) ready-to-eat cereal
1 roll or muffin
125 to 175 mL (½ – ¾ cup) cooked rice, macaroni, spaghetti or noodles
½ hamburger or wiener bun



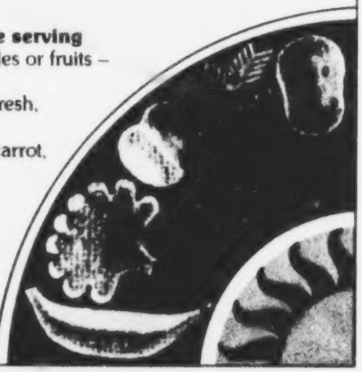
fruits and vegetables

4-5 servings

Include at least two vegetables.

Choose a variety of both vegetables and fruits — cooked, raw or their juices. Include yellow, green or green leafy vegetables.

Some examples of one serving
125 mL (½ cup) vegetables or fruits – fresh, frozen or canned
125 mL (½ cup) juice – fresh, frozen or canned
1 medium-sized potato, carrot, tomato, peach, apple, orange or banana



VEGETARIAN DAILY FOOD GUIDE

Milk and Milk Products Children 2-3 servings Adolescents 4 servings Adults 2 servings Pregnant women 4 servings Nursing mothers 4 1/2 servings	Examples of one serving: 1 cup (8 oz. or 250 mL) of milk (whole, 2% or skim) 1 cup (8 oz. or 250 mL) of yoghurt 1 1/2 ounces (45 grams) firm cheese 3 medium scoops ice cream 10 ounces (300 grams) tofu 1 ounce (30 grams) skim milk powder
Vegetable Protein Foods and Meat Alternates 2 servings	It is important to eat a variety of these foods to provide sufficient protein and iron. Examples of one serving: 1 cup (8 oz. or 250 mL) cooked soybeans, chick peas, lentils, kidney or navy beans 1/4 cup (2 oz. or 60 mL) peanuts or peanut butter 3/4 cup (6 oz. or 180 grams) tofu 3 ounces (90 grams) meat analogues or textured vegetable protein 1/2 cup (4 oz. or 125 mL) nuts such as cashews, pistachios, walnuts 1/2 cup (4 oz. or 125 mL) seeds, such as sunflower, sesame, pumpkin or squash 2 eggs
Fruits and Vegetables 5-6 servings	A large variety of fruits and vegetables should be eaten daily. It is important to consume sources of vitamins C and A daily. Some Vitamin C rich choices are: vitaminized apple juice, raw cabbage, oranges, grapefruit and their juices, baked potatoes, fresh strawberries, tomatoes and tomato juice. Some Vitamin A rich choices are: apricots, beet greens, chard and other dark green vegetables, cantaloupe, carrots, peaches, spinach, squash, yams. Example of one servings: 1/2 cup (4 oz. or 125 mL) fruit, vegetables or their juices.

Breads and Cereals 6-8 servings	A large variety from this group must be included in the diet to provide adequate protein, B-Complex vitamins and iron. Examples of one serving: 1 slice of whole grain or enriched bread 3/4 cup (6 oz. or 200 mL) enriched cereal 1/2 cup (4 oz. or 125 mL) cooked brown or converted rice 3/4 cup (6 oz. or 200 mL) cooked whole grain enriched or soy pasta products 1 tablespoon (15 mL) wheat germ

Source: B.C. Diet Manual, 1980 (adapted)

APPENDIX C

FOOD SOURCES OF NUTRIENTS

Note:-all values are for cooked meat, fish, poultry unless otherwise stated

-all values are for cooked vegetables unless stated otherwise

CALORIES AND PROTEIN - Average Values of Servings from Selected Food Groups

Recommended Intake of Calories:

	Age	
non-pregnant:	13-15	46 Kcal/kg
	16-18	40 Kcal/kg
	19-24	36 Kcal/kg
	25-49	32 Kcal/kg

pregnant:
+100 Kcal 1st trimester
+300 Kcal 2nd and 3rd trimesters

Recommended Intake of Protein:

	Age	
non-pregnant:	13-15	.89 g/kg
	16-18	.81 g/kg
	19-24	.74 g/kg
	25-49	.74 g/kg

pregnant:
+15 g 1st trimester
+20 g 2nd trimester
+25 g 3rd trimester

FOOD GROUP	SERVING SIZE		CALORIES	PROTEIN
Milk and Milk Products				
Milk: Whole	1 cup	250 mL	152	8
2%	1 cup	250 mL	116	8
Skim	1 cup	250 mL	80	8
Yoghurt, 2%, plain	3/4 cup	175 mL	128	9
Cheese, cheddar, processed	1-1/2 oz.	45 g	175	10
Cottage cheese, 2%	1/2 cup	125 mL	107	16
Ice Cream	1/2 cup	125 mL	152	3

Meats and Alternates				
Lean Meat, Fish, Poultry	2 oz.	60 g	110	14
Assorted Meat Products:				
Bologna Types (3" diameter)	1 slice	13 g	44	2
Salami Types (2" diameter)	1 slice	5 g	22	1
Link Sausage	1	20 g	81	4
Weiner	1	50 g	124	7
Alternatives:				
Egg	2		110	14
Legumes/lentils	1 cup	250 mL	229	15
Nuts	1/2 cup	125 mL	449	14
Seeds	1/2 cup	125 mL	262	13
Peanut Butter	4 Tbsp.	60 mL	400	16
Breads and Cereals				
Bread/chapatti/roti	1	25 g	68	2
Roll/muffin	1	50 g	136	4
Hot dog/Hamburger bun	1	50 g	136	4
Crackers	6-2" Sq.	15 g	68	2
Cereal, cooked	1/2 cup	125 mL	68	2
Cereal, ready-to-eat	3/4 cup	175 mL	68	2
Rice, cooked	1/2 cup	125 mL	68	2
Pasta	1/2 cup	125 mL	68	2

Fruits and Vegetables				
Fruit: Raw/fresh	1		64	1
Fruit: Unsweetened cooked juice	1/2 cup	125 mL	44	1
Vegetables:				
Salad type, raw or cooked	1/2 cup	125 mL	16	1
Starchy (e.g., carrots, parsnips)	1/2 cup	125 mL	44	1
Potato/corn	1/2 cup	125 mL	68	1
Soups				
Prepared with water	1/2 cup	125 mL	42	2
Creamed soup	1/2 cup	125 mL	100	3.5
Bean or pea soup	1/2 cup	125 ml	165	4
Fats				
Butter/margarine/oils	1 Tbsp.	5 mL	45	0
Mayonnaise, Thousand Island, Italian, French	2 Tsp.	10 mL	45	0

Extras

Sugar/jam/honey	1 tsp.	5 mL	20	0
Cake and icing	1/9 of 9" cake	114 g	408	4
Cookies	1	10 g	83	1
Chocolate bar	1 small	30 g	134	1
Pie (made with fruit)	1/6 of 9" pie	160 g	418	3
Chips - all kinds	10 chips	20 g	116	1
Pizza	1/8 of 14" pie	105 g	208	8
Soft drink	6 oz.	180 mL	72	0

References: Good Health Eating Guide, Canadian Diabetes Association, 1981

Nutrient Value of Some Common Foods, Health and Welfare, Canada, 1979.

FOOD SOURCES OF VITAMIN C

Recommended Intake - non-pregnant: 45 mg

- pregnant: + 0 mg 1st trimester
+20 mg 2nd trimester
+20 mg 3rd trimester

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Black currants	100 g	200
Pepper, red, sweet, raw	50 g	128
Broccoli, raw	100 g	113
Spinach, raw	100 g	102
Brussels sprouts	100 g	87
Cauliflower, raw	100 g	78
Grapefruit	200 g (1/2 med.)	76
Turnip greens	100 g	69
Cantaloupe	200 g (1/3 med.)	66
Kolrabi, raw	100 g	66
Pepper, sweet, green, raw	50 g	64
Cabbage, red, raw	100 g	61
Oranges, raw, peeled	100 g (1 med.)	61
Strawberries	100 g	59
Orange juice, fresh	125 mL (4 oz.)	58
Papaya	100 g (1/3 med.)	56
Orange juice, frozen diluted	125 mL (4 oz.)	51
Cabbage, raw	100 g	47
Grapefruit juice	125 mL (4 oz.)	46
Orange juice, canned	125 mL (4 oz.)	46
Peaches, frozen sliced	100 g	40
Apple juice	125 mL (4 oz.)	40
Liver, calf	100 g	37

Turnip, raw	100g	36
Mango	100 g (1/2 med.)	35
Cabbage	100 g	33
Coleslaw	100 g	29
Liver, beef	100 g	27
Asparagus	100 g	26
Raspberries	100 g	25
Summer squash	100 g	25
Tomatoes, raw	100 g	23
Sweet potatoes with skin	100 g	22
Liver, chicken	100 g	22
Blackberries	100 g	21
Potatoes	100 g	20

Source: Canadian Nutrient File, December, 1982.

FOOD SOURCES OF FOLACIN (FOLIC ACID)

	Age	Amount
Recommended Intake - non-pregnant:	13-15	160 ug
	16-18	160 ug
	19-24	165 ug
	25-49	165 ug
- pregnant:		+305 ug

Food	Portion Size (100 g = approx. 3.5 oz)	Content (ug)
Spinach, raw	100 g	203.5
Liver, chicken	100 g	200
Liver, beef or calf	100 g	200
Spinach	100 g	102
Beets	100 g	93
Almonds	100 g	82
Kidneys, beef	100 g	79.8
Peanuts	72 g (1/2 cup)	76.3
Brussel sprouts	100 g	64.5
Asparagus	100 g	64
Soybeans	100 g	61.5
Cantaloupe	200 g (1/3 med.)	61
Broccoli	100 g	61
Sweet potatoes, yams	100 g	52
Kidney beans	100 g	47
Beans, green snap, raw	100 g	44
Peanut butter	50 g (3 Tbsp.)	40
Orange juice, fresh and frozen	125 mL (4 oz.)	39
Avocado, raw	100 g	36
Cabbage, red, raw	100 g	35
Lentils	100 g	33.5
Corn, sweet	100 g	33

Beans, green, snap	100 g	33
Cauliflower, raw	100 g	31.5
Lima beans	100 g	31
Cabbage, raw	100 g	30
Pepper, red, sweet, raw	50 g	26
Salmon, canned, liquid and solid	100 g	26
Egg	50 g (1 med.)	24.5
Orange	100 g (1 med.)	24

Source: Canadian Nutrient File, December 1982

FOOD SOURCES OF VITAMIN B12

	Age	Amount
Recommended Intake - non-pregnant:	13-15	1.5 ug
	16-18	1.9 ug
	19-24	2.0 ug
	25-49	2.0 ug
- pregnant:		+1 ug

Food	Portion Size (100 g = approx. 3 1/2 oz.)	Content (ug)
Liver, beef	100 g	80
Kidneys, beef	100 g	31
Liver, chicken	100 g	19
Oysters	100 g	18
Crab	100 g	10
Sardines	100 g	10
Mackerel	100 g	9
Salmon	100 g	6.9
Trout	100 g	3
Lamb	100 g	2.8
Tuna	100 g	2.2
Beef	100 g	1.8
Veal	100 g	1.6
Scallops	100 g	1.2
Halibut	100 g	1.0
Milk	250 mL (1 cup)	.9
Shrimp	100 g	.9
Egg	50 g (1 med.)	.8
Pork	100 g	.7
Yoghurt	125 g (1/2 cup)	.7
Cheeses	25 g (1 oz.)	.4

Source: Canadian Nutrient File, December, 1982.

FOOD SOURCES OF THIAMIN

Recommended Intake - non-pregnant: .4 mg/1000 Kcal
- pregnant: .4 mg/1000 Kcal

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Torula yeast	25 g (2-1/2 Tbsp.)	4.6
Brewer's yeast	25 g (2-1/2 Tbsp.)	3.9
Pork	100 g	1.13
Sunflower seeds	50 g (1/3 cup)	.98
Brazil nuts	100 g (1/3 cup)	.96
Sausage, pork	100 g	.79
Cereal, ready-to-eat	25 g (1/2 to 1 cup)	.53
Kidneys, beef	100 g	.51
Salami, dry	100 g	.37
Peas, green, raw	100 g	.35
Peas, green	100 g	.28
Soybeans	100 g	.25
Liver, beef	100 g	.25
Peanuts	72 g (1/2 cup)	.23
Cashew nuts	50 g (1/2 cup)	.22
Lima beans	100 g	.18
Wheat germ	8.5 g (2 Tbsp.)	.17
Oysters	100 g	.17
Asparagus	100 g	.16
Crab	100 g	.16
Lamb	100 g	.16
Salmon	100 g	.16
Liver, chicken	100 g	.15
Turnip greens	100 g	.15
White beans	100 g	.14
Corn, sweet	100 g	.14
Raisins	100 g	.11

Potatoes	100 g	.12
Avocado	100 g	.11
Cauliflower, raw	100 g	.11
Broccoli, raw	100 g	.10
Pineapple, canned	100 g	.10
Spinach, raw	100 g	.10
Milk, 2%	250 mL (1 cup)	.10
Muffin	50 g (1 muffin)	.10
Orange Juice	125 mL (4 oz.)	.10
Hamburger	100 g	.09
Broccoli	100 g	.09
Cabbage, raw	100 g	.09
Cauliflower	100 g	.09
Pineapple, raw	100 g	.09
Rice, brown	100 g	.09
Bread, pumpernickel	32 g (1 slice)	.08
Bread, whole wheat	25 g (1 slice)	.07
Peanut butter	50 g (3 Tbsp.)	.07

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF RIBOFLAVIN (B2)

Recommended Intake - non-pregnant: .5 mg/1000 Kcal
- pregnant: .5 mg/1000 Kcal + .30 mg/day

Food	Portion Size (100 g = approx. 3.5 oz)	Content (mg)
Beef kidneys	100 g	4.8
Liver, beef	100 g	4.2
Liver, chicken	100 g	2.6
Sausage, liverwurst	100 g	1.4
Cereals, ready-to-eat, enriched	25 g (1/2 to 1 cup)	.9-1.5
Torula yeast	25 g (2-1/2 Tbsp.)	1.3
Almonds	100 g	.9
Milk, 2%, white or chocolate	250 mL (1 cup)	.4
Milk, whole	250 mL (1 cup)	.4
Buttermilk	250 mL (1 cup)	.4
Milk, skim	250 mL (1 cup)	.4
Goat milk	250 mL (1 cup)	.4
Sausage, pork	100 g	.3
Mackerel	100 g	.3
Mushrooms	100 g	.3
Pork	100 g	.3
Macaroni, spaghetti	100 g	.3
Veal	100 g	.3
Lamb	100 g	.3
Trout	100 g	.3
Split peas	100 g	.3
Yoghurt, made with skim milk	125 g (1/2 cup)	.3
Sardines, in tomato sauce	100 g	.3
Ricotta cheese	100 g	.2

Broccoli, raw	100 g	.2
Feta cheese	100 g	.2
Avocado	100 g	.2
Asparagus, raw	100 g	.2
Oysters, canned, solids and liquid	100 g	.2
Salmon, canned, solids and liquid	100 g	.2
Turkey	100 g	.18
Cashew nuts	50 g (1/2 cup)	.15
Chicken	100 g	.15
Muffin	50 g (1 muffin)	.1
Bread, whole wheat	50 g (1 slice)	.08

Source: Canadian Nutrient File, December, 1982.

FOOD SOURCES OF NIACIN (B3)

Recommended Intake - non-pregnant: 7.2 NE per 1000 Kcal
- pregnant: 7.2 NE per 1000 Kcal

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Liver, beef	100 g	23.0
Tuna, canned in oil	100 g	16.6
Peanuts	72 g (1/2 cup)	16.5
Chicken	100 g	14.6
Turkey	100 g	14.0
Salmon	100 g	14.5
Sardines, canned, drained	100 g	13.7
Pork	100 g	13.4
Beef, lean	100 g	12.5
Mackerel, canned, solids and liquid	100 g	12.3
Lamb	100 g	11.8
Salmon, canned, solids and liquid	100 g	11.2
Sausage, liverwurst	100 g	11.0
Veal	100 g	11.0
Cod	100 g	10.6
Peanut butter	50 g (3 Tbsp.)	10.4
Sausage, salami	100 g	8.6
Trout	100 g	8.6
Herring, smoked	100 g	7.3
Sausage, pork	100 g	6.5
Haddock, smoked	100 g	6.0
Sunflower seeds	50 g (1/3 cup)	5.5
Shrimp, canned	100 g	5.5
Brazil nuts	100 g (1/3 cup)	4.7
Crab, canned	100 g	4.7

Oysters	100 g	4.4
Scallops	100 g	3.9
Soybeans	100 g	3.5
Almonds	50 g (1/3 cup)	3.2
Cashews	33 g (1/3 cup)	3.2
Muffin, bran	50 g (1 muffin)	2.7
Bread, whole wheat 100%	25 g (1 slice)	1.2
Shredded wheat	25 g (1 biscuit)	1.1

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF PANTOTHENIC ACID

Recommended Intake - non-pregnant: 5-7 mg (suggested intake)
- pregnant: not yet known

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Liver, beef	100 g	7.7
Kidneys, beef	100 g	3.9
Brewer's yeast, torula yeast	25 g (2-1/2 Tbsp.)	3.0
Peanuts	72 g (1/2 cup)	1.5
Chicken	100 g	1.0
Broccoli	100 g	1.2
Avocado	100 g (1/3 med.)	1.0
Cauliflower	100 g	1.0
Pecans	54 g (1/2 cup)	.92
Egg	50 g (1 med.)	.86
Milk	250 mL (1 cup)	.8
Sweet potatoes, baked	100 g	.8
Pork	100 g	.8
Peas, green, canned	100 g	.75
Beef	100 g	.7
Whole wheat cereals	25 g (1/2 to 1 cup)	.7
Asparagus	100 g	.6
Crab	100 g	.6
Salmon, canned	100 g	.6
Soybeans	100 g	.5

Sunflower seeds	33 g (1/4 cup)	.5
Lima beans	100 g	.47
Squash	100 g	.4
Potatoes	100 g	.38
Wheat germ	25 g (2-1/2 Tbsp.)	.3
Almonds	50 g (1/3 cup)	.24

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF B6 (Pyridoxine)

Recommended Intake - non-pregnant: .015 mg/g protein

example: 41 g protein, .6 mg B_6

- pregnant: .015 mg/g protein

example: 61 g protein, .9 mg B_6

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Sunflower seeds	50 g (1/3 cup)	1.07
Liver, beef	100 g	.84
Torula yeast	25 g	.75
Salmon	100 g	.7
Mackerel	100 g	.66
Banana	100 g (1 med.)	.5
Turkey	100 g	.46
Pork	100 g	.45
Beef	100 g	.43
Halibut	100 g	.43
Tuna, canned, solids and liquid	100 g	.42
Avocado	100 g	.42
Chicken	100 g	.41
Lamb	100 g	.36
Raisins	100 g	.35
Veal	100 g	.34
Crab	100 g	.30
Peanuts	72 g (1/2 cup)	.30
Salmon, canned, solids and liquid	100 g	.30
Wheat germ	25 g	.29
Corn, sweet	100 g (3/4 cup)	.28

Sardines	100 g	.28
Spinach	100 g	.28
Lamb	100 g	.27
Turnip greens	100 g	.27
Soybeans	100 g	.25
Potato	100 g	.25
Brewer's yeast	25 g (2-1/2 Tbsp.)	.24
Lima beans	100 g	.23
Brussel sprouts	100 g	.23
Perch	100 g	.23
Cod	100 g	.22
Sweet potatoes	100 g	.21
Cauliflower	100 g	.21
Cereal, ready-to-eat	25 g (1/2 to 1 cup)	.20
Cabbage, red, raw	100 g	.20
Broccoli	100 g	.19
Tomato juice	109 mL (3-1/2 oz.)	.19
Haddock	100 g	.18
Peanut butter	50 g (3 Tbsp.)	.17
Asparagus	100 g	.15
Kidney beans	100 g	.15
Squash (all types)	100 g	.15
Pepper, sweet, green, raw	50 g	.13
Milk, 2%	250 mL (1 cup)	.11
Goat milk	250 mL (1 cup)	.11
Muffin	50 g (1 muffin)	.10

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF VITAMIN A

Recommended Intake - non pregnant: 800 RE
- pregnant: +100 RE

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (RE)
Liver, beef	100 g	16,020
Liver, chicken	100 g	6,165
Liverwurst	100 g	1,959
Dandelion greens	100 g	1,170
Apricots, dried	100 g	1,410
Carrots	100 g	1,100
Spinach	100 g	810
Sweet potatoes	100 g	810
Mustard greens	100 g	700
Cantaloupe	200 g (1/3 med.)	680
Crab	100 g	651
Winter and butternut squash	100 g	640
Swiss chard	100 g	540
Beet greens	100 g	510
Mango	100 g (1/2 med.)	480
Pepper, sweet, red	100 g	445
Hubbard squash	100 g	410
Beef kidney	100 g	345
Endive	100 g	330
Apricots	100 g (3 med.)	300
Broccoli	100 g	260
Prunes, dried	100 g	217
Halibut	100 g	204
Romaine	100 g	190
Papaya	100 g (1/3 med.)	175
Parsley	30 mL (1 Tbsp.)	170

Nectarine	100 g	165
Milk, skim - fortified	250 mL (1 cup)	158
Ice cream	100 g	156
Chocolate milk 2%	250 mL (1 cup)	150
Milk 2%	250 mL (1 cup)	147
Goat milk	250 mL (1 cup)	144
Ricotta cheese	100 g	134
Peaches	100 g (1 med.)	133
Plums	100 g (2 med.)	125
Cream cheese	100 g	109
Asparagus	100 g	90
Tomatoes	100 g	90
Tomato juice	250 mL (1 cup)	90
Milk, whole	250 mL (1 cup)	80
Egg, whole	1	78
Cheddar cheese	28 g (1 oz.)	75

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF VITAMIN D

Recommended Intake - non-pregnant: 2.5 ug or 100 I.U. cholecalciferol
- pregnant: +2.5 ug or 100 I.U. cholecalciferol

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (I.U.)
Fish (herring, salmon, tuna average value)	100 g	300
Milk, fortified	250 mL (1 cup)	100
Liver (average value)	100 g	30
Egg yolk	1 large	27
Butter	1 Tbsp.	14

Source: Nutrition and Physical Fitness, G.M. Briggs and D.H. Calloway, W.B. Saunders Co., 1979, p. 148.

FOOD SOURCES OF VITAMIN E

	Age	Amount
Recommended Intake - non-pregnant:	13-15	7 mg
	16-18	7 mg
	19-24	7 mg
	25-49	6 mg
- pregnant:		+2 mg

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Tuna (oil packed, drained)	100 g	9.0
Peanuts	72 g (1/2 cup)	8.6
Sweet potatoes	100 g	6.0
Avocado	100 g	5.0
Almonds	100 g	4.4
Vegetable oils	4.6 g (1 tsp.)	2.9-4.3
Blackberries	100 g	4.0
Asparagus	100 g	3.7
Peanut butter	50 g (3 Tbsp.)	3.5
Salad dressing	4.7 g (1 tsp.)	3.1
Swiss chard, spinach	100 g	3.0
Margarine	4.7 g (1 tsp.)	2.7
Lobster, salmon	100 g	2.2
Wheat germ	25 g (2-1/2 Tbsp.)	2.6
Tomatoes	100 g	1.8
Broccoli	100 g	1.6
Halibut	100 g	1.5
Parsnips	100 g	1.5
Brussel Sprouts	100 g	1.3
Egg	50 g (1 med.)	1.2
Green pepper	100 g	1.2
Beef heart	100 g	1.1
Plums	100 g	1.1

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF ZINC

Recommended Intake - non-pregnant: 8 mg

- pregnant: +0 mg 1st trimester
+1 mg 2nd trimester
+2 mg 3rd trimester

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Oysters	100 g	148.7
Liver, calf	100 g	6.2
Beef	100 g	5.8
Crab	100 g	5.5
Lamb	100 g	4.3
Veal	100 g	4.1
Kidneys	100 g	3.0
Sardines	100 g	3.0
Chicken	100 g	2.8
Herring	100 g	2.7
Pork	100 g	2.6
Turkey	100 g	2.5
Shrimp	100 g	2.4
Pecans	54 g (1/2 cup)	2.2
Bananas	1 med.	2.0
Lobster	100 g	1.8
Salami	100 g	1.7
Sausage, pork	100 g	1.2
Peanut butter, peanuts	50 g (3 Tbsp.)	1.2
Almonds	50 g (1/3 cup)	1.2
Yoghurt	125 g (1/2 cup)	1.2
Milk	250 mL (1 cup)	1.0
Beans, dried, cooked	100 g	1.0

Beans, lima	100 g	1.0
Corn, sweet	100 g	1.0
Cheese, swiss, gruyere	25 g (1 oz.)	1.0
Salmon, canned	100 g	.9
Whole, grain cereals, ready-to-eat	25 g (1/2 to 1 cup)	.8
Peas, canned	100 g	.8
Tuna, canned	100 g	.8
Goat milk	250 mL (1 cup)	.8
Cheese, cheddar	50 g (1 med.)	.8
Egg	50 g (1 med.)	.72
Lentils	100 g	.6
Brown rice	100 g	.6
Cod	100 g	.5
Whole grain bread	25 g (1 slice)	.4

Source: Canadian Nutrient File, December, 1982.
Introductory Nutrition, H.A. Guthrie, C.V. Mosby Co., 1979, p. 197.

FOOD SOURCES OF IRON

	Age	Amount
Recommended Intake - non-pregnant:	13-15	13 mg
	16-18	14 mg
	19-24	14 mg
	25-49	14 mg
- pregnant:		+6 mg

Total iron content of the diet is no longer considered to be a good indicator of iron intake. [illegible] is necessary to consider the type of iron (heme or non-heme) and [illegible] factors affecting the absorption of each. Iron status of the individual affects the absorption of both heme and non-heme iron, whereas the composition of the meal affects non-heme iron absorption only.

Sources of heme iron are meat, fish, poultry, 30-60% of the iron in these foods is heme iron. As iron stores decrease, heme iron absorption increases.

Sources of non-heme iron are vegetables; grains; fruits; eggs; the non-heme portion of iron in meats, fish, poultry; and iron supplements. As iron stores decrease, non-heme iron absorption increases. The composition of the meal influences the absorption of non-heme iron. Absorption enhancers include vitamin C, meat, fish, poultry. Absorption inhibitors include tea, coffee, phosvitin of egg yolk, phytates, calcium and phosphate salts, EDTA (a preservative) and antacids.

Availability of Iron in Different Meals

HIGH AVAILABILITY	3 oz. meat, fish or poultry OR 75 mg vitamin C, OR 1-3 oz. meat, fish or poultry plus 25-75 mg vitamin C
MEDIUM AVAILABILITY	1-3 oz. meat, fish or poultry OR 25-75 mg vitamin C

LOW
AVAILABILITY 1 oz. meat OR 25 mg vitamin C

The absorption of iron increases as iron stores decrease. The figures in the following Table are based on iron stores of 500 mg, the level of stores considered adequate for a female.

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg) for Low, Medium and High Levels of Availability		
		Low	Medium	High
Liver, pork	100 g		3.55	4.08
Liver, lamb	100 g		2.21	2.53
Liver, calf	100 g		1.71	1.99
Kidney	100 g		1.60	1.84
Liver, beef	100 g		1.08	1.24
Abalone, canned	100 g		1.08	1.24
Liver, chicken	100 g		1.03	1.18
Oysters	100 g		1.00	1.16
Game	100 g		.81	0.93
Trout	100 g		.65	.74
Clams	100 g		.74	.86
Heart, beef	100 g		.73	.84
Duck	100 g		.61	.71
Enriched cream of wheat	125 mL(1/2 cup)	.28	.47	.74
Pumpkin seeds, hulled	125 mL(1/2 cup)	.28	.47	.74
Beef	100 g		.45	.52
Pork	100 g		.45	.52
Veal	100 g		.41	.47
Blackstrap molasses	30 mL(2 Tbsp.)	.24	.39	.63
Ham	100 g		.39	.45
Shrimp, canned	100 g		.38	.44
Scallops	100 g		.37	.42

		Low	Medium	High
Sardines, canned	100 g		.35	.40
Cereals, enriched, ready-to-eat	175 mL(3/4 cup)	.20	.34	.54
Torula yeast	1 oz	.20	.33	.52
Prune juice	125 mL(1/2 cup)	.19	.31	.50
Pistachio nuts	125 mL(1/2 cup)	.18	.31	.48
White beans	250 mL(1 cup)	.16	.26	.42
Chickpeas (garbanzos)	250 mL(1 cup)	.15	.25	.39
Tongue	100 g		.27	.31
Kidney beans	250 mL(1 cup)	.13	.22	.35
Soybeans	250 mL(1 cup)	.13	.22	.34
Lentils	250 mL(1 cup)	.13	.21	.34
Lima beans	250 mL(1 cup)	.12	.21	.33
Lamb	100 g		.25	.28
Tuna, canned	100 g		.24	.27
Walnuts	125 mL(1/2 cup)	.11	.19	.30
Almonds	125 mL(1/2 cup)	.11	.19	.30
Turkey	100 g		.21	.25
Tofu	170 g	.10	.17	.28
Split peas	250 mL(1 cup)	.10	.17	.27
Chicken	100 g		.19	.22
Herring	100 g		.19	.21
Cashew nuts	125 mL(1/2 cup)	.08	.13	.21
Molasses, medium	30 mL(2 Tbsp.)	.08	.13	.20
Fish (haddock, cod, halibut - average value)	100 g		.10	.11
Sunflower seeds	125 mL(1/2 cup)	.06	.10	.16
Molasses, light	30 mL(2 Tbsp.)	.05	.09	.14
Peaches, dried	30 g	.05	.09	.14
Apricots, dried	30 g	.05	.08	.13
Green beans	125 mL(1/2 cup)	.04	.07	.12
Peanuts	100 mL(1/3 cup)	.03	.05	.09

		Low	Medium	High
Raisins	30 g	.03	.05	.08
Prunes	30 g	.03	.05	.08
Wheat germ, toasted	30 mL(2 Tbsp.)	.03	.05	.08
Whole wheat bread	25 g(1 slice)	.02	.04	.06
Cereals, whole grain	125-200 mL(1/2) to 3/4 cup	.02	.03	.05

Source: Nutritive value of American Foods in Common Units, U.S.D.A. Handbook No. 456, November, 1976.

Nutrient Value of Some Common Foods, Health and Welfare Canada, 1979.

Food Composition Table for Use in East Asia, U.S. Department of Health, Education and Welfare, 1972.

FOOD SOURCES OF CALCIUM

	Age	Amount
Recommended Intake - non-pregnant:	13-15	800 mg
	16-18	700 mg
	19-24	700 mg
	25-49	700 mg
- pregnant:		+500 mg

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Sardines	100 g	440
Milk, skim	250 mL (1 cup)	319
Milk, 2%	250 mL (1 cup)	314
Milk, whole	250 mL (1 cup)	308
Buttermilk	250 mL (1 cup)	301
Milk, chocolate, whole	250 mL (1 cup)	296
Cheese, romano or parmesan	28 g (1 oz.)	266
Salmon, canned, with bones	100 g	259
Cheese, gruyere	25 g (1 oz.)	253
Yoghurt, plain, from skim milk	125 (1/2 cup)	249
Milk, skim milk powder	17.5 g (1/4 cup)	229
Yoghurt, plain, 2%	100 g	228
Bannock	100 g	227
Brazil nuts	100 g (1/3 cup)	186
Mackerel	100 g	185
Cheese, Edam or Swiss	25 g (1 oz.)	183
Cheese, cheddar	25 g (1 oz.)	180
Collards	100 g	152
Oysters	100 g	152
Herring	100 g	147

Figs, dried	100 g	126
Soybean curd (tofu)	100 g	125
Cheese, feta	25 g (1 oz.)	123
Scallops, shrimp	100 g	115
Soybeans, cooked	100 g	115
Filberts	50 g (1 cup)	105
Broccoli	100 g	103
Sunflower seeds	50 g (1/3 cup)	90
Almonds	50 g (1/3 cup)	78

Source: Canadian Nutrient File, December, 1982

FOOD SOURCES OF MAGNESIUM

	Age	Amount	
Recommended Intake - non-pregnant:	13-15	190 mg	
	16-18	220 mg	
	19-24	190 mg	
	25-49	190 mg	
- pregnant:		+15 mg	1st trimester
		+20 mg	2nd trimester
		+25 mg	3rd trimester

Food	Portion Size (100 g = approx. 3.5 oz.)	Content (mg)
Almonds	50 g (1/3 cup)	150
Figs, dried	100 g (5 figs)	92
Bran flakes	25 g (1 cup)	91.8
Peanut butter	50 g (3 Tbsp.)	90
Apricots, raw	100 g (3 med.)	65
Spinach	100 g	59
Beans, kidney	100 g	45
Banana	100 g (1 med.)	42
Scallops	100 g	38
Milk	250 mL (1 cup)	35
Crab	100 g	32
Trout	100 g	31
Salmon, canned, solids and liquid	100 g	30
Avocado	100 g (1/2 med.)	29
Turkey	100 g	26
Chicken, dark meat	100 g	21

Note: all of the following groups of foods contribute magnesium:

dairy products
fruits and vegetables
meat and eggs
dried peas and beans
cereals

Source: Canadian Nutrient File, December, 1982

APPENDIX D

HEIGHT/WEIGHT TABLES

1983 METROPOLITAN LIFE WEIGHT TABLE FOR WOMEN

Weights at Ages 25 - 59 Based on Lowest Mortality

Weights Include 1.4 kg (3 pounds) Indoor Clothing

HEIGHTS INCLUDE 2.5 cm (1") HEELS				SMALL FRAME		MEDIUM FRAME		LARGE FRAME	
Ft.	inches	inches	cm	lb.	Kg	lb.	Kg	lb.	Kg
4'	10"	58"	147	102-111	46-50	109-121	50-55	118-131	54-60
4'	11"	59"	150	103-113	47-51	111-123	50-56	120-134	54-61
5'	0"	60"	152	104-115	47-52	113-126	51-57	122-137	55-62
5'	1"	61"	155	106-118	48-54	115-129	52-59	125-140	57-64
5'	2"	62"	158	108-121	49-55	118-132	54-60	128-143	58-65
5'	3"	63"	160	111-124	50-56	121-135	55-61	131-147	59-67
5'	4"	64"	163	114-127	52-58	124-138	56-63	134-151	61-69
5'	5"	65"	165	117-130	53-59	127-141	58-64	137-155	62-70
5'	6"	66"	168	120-133	55-61	130-144	59-66	140-159	64-72
5'	7"	67"	170	123-136	56-62	133-147	60-67	143-163	65-74
5'	8"	68"	173	126-139	57-63	136-150	62-68	146-167	66-76
5'	9"	69"	175	129-142	58-64	139-153	63-69	149-170	67-77
5'	10"	70"	178	132-145	60-66	142-156	65-71	152-173	69-79
5'	11"	71"	180	135-148	61-67	145-159	66-72	155-176	70-80
6'	0"	72"	183	138-151	62-68	148-162	67-73	158-179	71-81

Source of basic data: 1979 Build Study, Society of Actuaries and Association of Life Insurance Medical Directors of America, 1980.
For females between 18 and 25 years, subtract .45 kg (1 pound) for each year under 25.
For adolescent females, refer to National Centre for Health Statistics (N.C.H.S.) Growth Chart.
1 kg = 2.2 lb.

ESTIMATING FRAME SIZE

Holding the arm up, extend the arm and bend the forearm upward at a 90 degree angle. Keep fingers straight and turn the inside of wrist toward the body. If you have a caliper, use it to measure the space between the outermost part of the two prominent bones on either side of the elbow. Without a caliper, place thumb and index finger of your other hand on these two bones.* Measure the space between the inside of your fingers against a ruler or tape measure. Refer to the table to the right which lists elbow measurements for medium framed men and women. Measurements lower than those listed indicate you have a small frame. Higher measurements indicate a large frame.

WOMEN Height in 1 Inch (2.5 cm) Heels		ELBOW BREADTH for Medium Frame**	
INCHES	cm	INCHES	cm
4'10" - 4'11"	148-151	2 1/4 - 2 1/2	5.6 - 6.4
5' 0" - 5' 3"	152-161	2 1/4 - 2 1/2	5.8 - 6.5
5' 4" - 5' 7"	162-171	2 3/8 - 2 5/8	5.9 - 6.6
5' 8" - 5'11"	172-181	2 3/8 - 2 5/8	5.9 - 6.8
6' 0"	182	2 1/2 - 2 3/4	6.2 - 6.9

* a protractor helps

** Measurements lower than listed = SMALL FRAME

Measurements higher than listed = LARGE FRAME

ASSESSING UNDERWEIGHT FOR WOMEN AGES 25 - 59
(90% of mid-range of Metropolitan Life weights)

Heights include 2.54 cm (1") heels

Weights include 1.4 kg (3 pounds) indoor clothing

		SMALL FRAME	MEDIUM FRAME	LARGE FRAME
cm	Ft.	kg (lbs.)	kg (lbs.)	kg(lbs.)
147	4' 10"	43.5(96)	47.2(104)	50.8(112)
150	4' 11"	43.9(97)	47.6(105)	51.7(114)
152	5' 0"	44.9(99)	49.0(108)	53.0(117)
155	5' 1"	45.8(101)	50.0(110)	54.0(119)
158	5' 2"	46.7(103)	51.3(113)	55.3(122)
160	5' 3"	48.0(106)	52.2(115)	56.7(125)
163	5' 4"	49.4(109)	53.5(118)	58.0(128)
165	5' 5"	50.3(111)	54.9(121)	59.4(131)
168	5' 6"	51.7(114)	55.8(123)	61.2(135)
170	5' 7"	53.0(117)	57.2(126)	62.6(138)
173	5' 8"	54.0(119)	58.5(129)	64.0(141)
175	5' 9"	55.3(122)	59.4(131)	65.3(144)
178	5' 10"	56.7(125)	60.8(134)	66.2(146)
180	5' 11"	57.6(127)	62.1(137)	67.6(149)
183	6' 0"	59.0(130)	63.5(140)	68.9(152)

ASSESSING OVERWEIGHT FOR WOMEN AGES 25 - 59

(120% of mid-range of Metropolitan Life weights)

Heights include 2.54 cm (1") heels

Weights include 1.4 kg (3 pounds) indoor clothing

		SMALL FRAME	MEDIUM FRAME	LARGE FRAME
cm	Ft.	kg (lbs.)	kg(lbs.)	kg(lbs.)
147	4' 10"	58.0(128)	62.6(138)	67.6(149)
150	4' 11"	59.0(130)	63.5(140)	23.6(152)
152	5' 0"	59.4(131)	64.9(143)	70.3(155)
155	5' 1"	60.8(134)	66.2(146)	72.1(159)
158	5' 2"	62.1(137)	68.0(150)	73.9(163)
160	5' 3"	64.0(141)	69.9(154)	75.8(167)
163	5' 4"	65.8(145)	71.2(157)	77.6(171)
165	5' 5"	67.1(148)	73.0(161)	79.4(175)
168	5' 6"	68.9(152)	74.4(164)	81.2(179)
170	5' 7"	70.3(155)	76.2(168)	83.5(184)
173	5' 8"	72.1(159)	78.0(172)	85.3(188)
175	5' 9"	73.9(163)	79.4(175)	86.6(191)
178	5' 10"	75.3(166)	81.2(179)	88.5(195)
180	5' 11"	77.1(170)	82.6(182)	90.3(199)
183	6' 0"	78.5(173)	84.4(186)	91.6(202)

EXPECTED WEIGHT-FOR-HEIGHT OF ADULT WOMEN DURING PREGNANCY

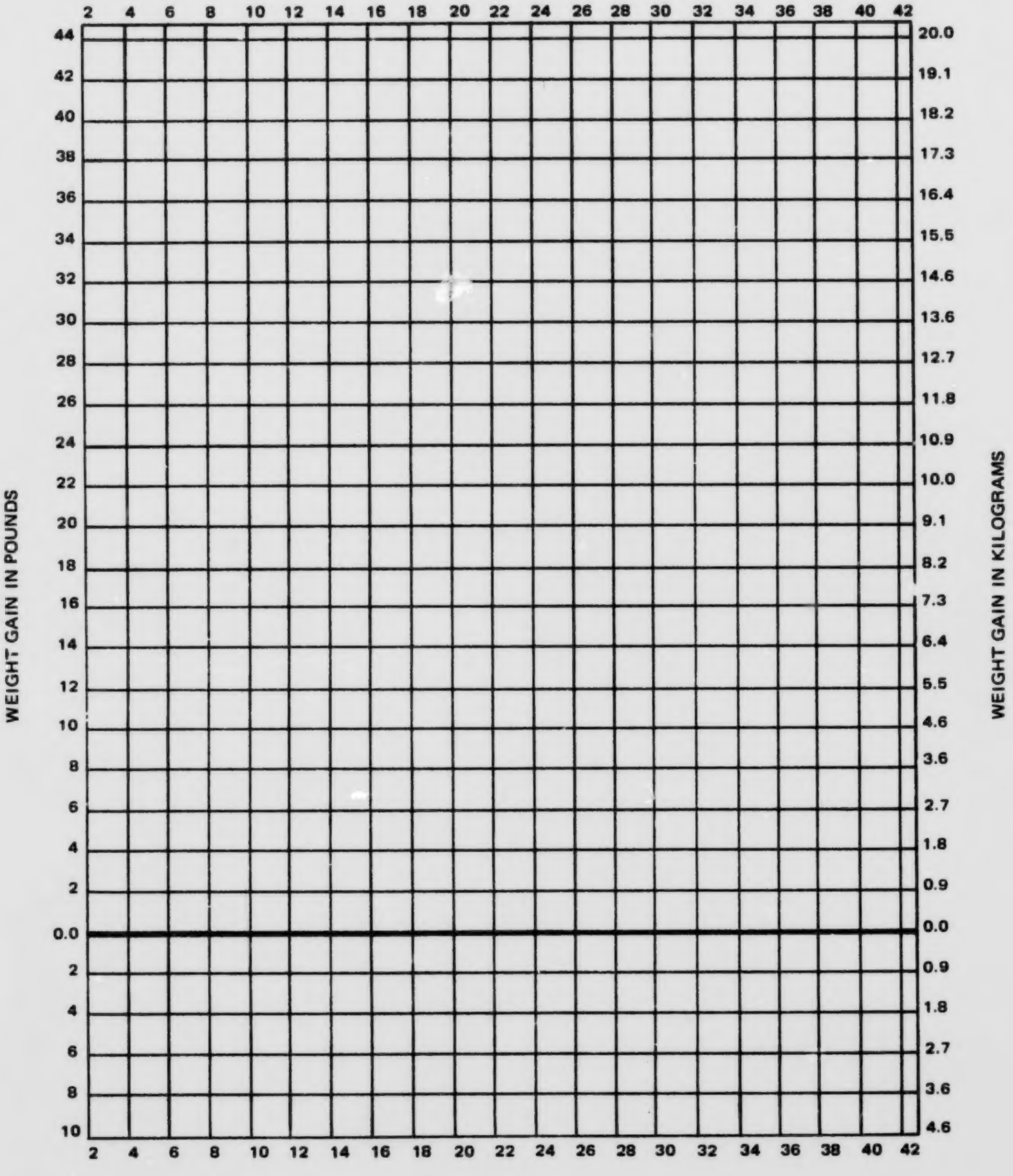
BY WEEK OF PREGNANCY*

Ht	Prepregnant wt	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
cm	kg																												
140	48.6	49.5	49.8	50.1	50.5	50.8	51.1	51.5	51.8	52.1	52.4	52.8	53.1	53.4	53.8	54.1	54.4	54.8	55.1	55.4	55.7	56.1	56.4	56.7	57.1	57.4	57.7	58.0	58.4
141	49.2	50.0	50.3	50.7	51.0	51.3	51.7	52.0	52.4	52.7	53.0	53.4	53.7	54.0	54.4	54.7	55.0	55.4	55.7	56.0	56.4	56.7	57.0	57.4	57.7	58.0	58.4	58.7	59.0
142	49.7	50.5	50.9	51.2	51.6	51.9	52.2	52.6	52.9	53.3	53.6	53.9	54.3	54.6	54.9	55.3	55.6	56.0	56.3	56.6	57.0	57.3	57.6	58.0	58.3	58.6	59.0	59.3	59.7
143	50.2	51.1	51.4	51.8	52.1	52.5	52.8	53.1	53.5	53.8	54.2	54.5	54.8	55.2	55.5	55.9	56.2	56.5	56.9	57.2	57.6	57.9	58.2	58.6	58.9	59.3	59.6	60.0	60.3
144	50.8	51.6	52.0	52.3	52.7	53.0	53.4	53.7	54.0	54.4	54.7	55.1	55.4	55.8	56.1	56.5	56.8	57.1	57.5	57.8	58.2	58.5	58.9	59.2	59.6	59.9	60.2	60.6	60.3
145	51.3	52.2	52.5	52.9	53.2	53.6	53.9	54.3	54.6	55.0	55.3	55.7	56.0	56.3	56.7	57.0	57.4	57.7	58.1	58.4	58.8	59.1	59.5	59.8	60.2	60.5	60.9	61.2	61.6
146	51.8	52.7	53.1	53.4	53.8	54.1	54.5	54.9	55.2	55.5	55.9	56.2	56.6	56.9	57.3	57.6	58.0	58.3	58.7	59.0	59.4	59.7	60.1	60.4	60.8	61.1	61.5	61.8	62.2
147	52.4	53.2	53.6	54.0	54.3	54.7	55.0	55.4	55.7	56.1	56.4	56.8	57.2	57.5	57.9	58.2	58.6	58.9	59.3	59.6	60.0	60.4	60.7	61.1	61.4	61.8	62.1	62.5	62.8
148	52.9	53.8	54.1	54.5	54.9	55.2	55.6	55.9	56.3	56.7	57.0	57.4	57.7	58.1	58.5	58.8	59.2	59.5	59.9	60.2	60.6	61.0	61.3	61.7	62.0	62.4	62.8	63.1	63.5
149	53.4	54.3	54.7	55.1	55.4	55.8	56.1	56.5	56.9	57.2	57.6	58.0	58.3	58.7	59.0	59.4	59.8	60.1	60.5	60.9	61.2	61.6	61.9	62.3	62.7	63.0	63.4	63.7	64.1
150	53.9	54.9	55.2	55.6	56.0	56.3	56.7	57.1	57.4	57.8	58.2	58.5	58.9	59.3	59.6	60.0	60.4	60.7	61.1	61.5	61.8	62.2	62.6	62.9	63.3	63.6	64.0	64.4	64.7
151	54.5	55.4	55.7	56.1	56.5	56.9	57.3	57.6	58.0	58.4	58.7	59.1	59.5	59.8	60.2	60.6	60.9	61.3	61.7	62.1	62.4	62.8	63.2	63.5	63.9	64.3	64.6	65.0	65.4
152	55.0	55.9	56.3	56.7	57.1	57.4	57.8	58.2	58.6	58.9	59.3	59.7	60.1	60.4	60.8	61.2	61.5	61.9	62.3	62.7	63.0	63.4	63.8	64.2	64.5	65.9	65.3	65.6	66.0
153	55.5	56.5	56.9	57.2	57.6	58.0	58.4	58.7	59.1	59.5	59.9	60.3	60.6	61.0	61.4	61.8	62.1	62.5	62.9	63.3	63.6	64.0	64.4	64.8	65.1	65.5	65.9	66.3	66.7
154	56.1	57.0	57.4	57.8	58.2	58.5	59.0	59.3	59.7	60.1	60.4	60.8	61.2	61.6	62.0	62.3	62.7	63.1	63.5	63.9	64.2	64.6	65.0	65.4	65.8	66.1	66.5	66.9	67.3
155	56.6	57.6	57.9	58.3	58.7	59.1	59.5	59.9	60.3	60.6	61.0	61.4	61.8	62.2	62.6	62.9	63.3	63.7	64.1	64.5	64.9	65.2	65.6	66.0	66.4	66.8	67.2	67.5	67.9
156	57.1	58.1	58.5	58.9	59.3	59.7	60.0	60.4	60.8	61.2	61.6	62.0	62.4	62.8	63.1	63.5	63.9	64.3	64.7	65.5	65.5	65.9	66.2	66.6	67.0	67.4	67.8	68.2	68.6
157	57.2	58.6	59.0	59.4	59.8	60.2	60.6	61.0	61.4	61.8	62.2	62.5	62.9	63.3	63.7	64.1	64.5	64.9	65.3	66.1	66.1	66.5	66.9	67.2	67.6	68.0	68.4	68.8	69.2
158	58.2	59.2	59.6	60.0	60.4	60.8	61.2	61.6	61.9	62.3	62.7	63.1	63.5	63.9	64.3	64.7	65.1	65.5	65.0	66.7	66.7	67.1	67.5	67.9	68.3	68.6	69.0	69.4	69.8
159	58.7	59.7	60.1	60.5	60.9	61.3	61.7	62.1	62.5	62.9	63.3	63.7	64.1	64.5	64.9	65.3	65.7	66.1	66.5	67.3	67.3	67.7	68.1	68.5	68.9	69.3	69.7	70.1	70.5
160	59.2	60.3	60.7	61.1	61.5	61.9	62.3	62.7	63.1	63.5	63.9	64.3	64.7	65.1	65.5	65.9	66.3	66.7	67.1	67.5	67.9	68.3	68.7	69.1	69.5	69.9	70.3	70.7	71.1
161	59.8	60.8	61.2	61.6	62.0	62.4	62.8	63.2	63.6	64.0	64.4	64.9	65.3	65.7	66.1	66.5	66.9	67.3	67.7	68.1	68.5	68.9	69.3	69.7	70.1	70.5	70.9	71.3	71.7
162	60.3	61.3	61.7	62.2	62.6	63.0	63.4	63.8	64.2	64.6	65.0	65.4	65.8	66.2	66.7	67.1	67.5	67.9	68.3	68.7	69.1	69.5	69.9	70.3	70.7	71.2	71.6	72.0	72.4
163	60.8	61.9	62.3	62.7	63.1	63.5	63.9	64.4	64.8	65.2	65.6	66.0	66.4	66.8	67.2	67.7	68.1	68.5	68.9	69.3	69.7	70.1	70.5	71.0	71.4	71.8	72.2	72.6	73.0
164	61.4	62.4	62.8	63.3	63.7	64.1	64.5	64.9	65.3	65.7	66.2	66.6	67.0	67.4	67.8	68.2	68.7	69.1	69.5	69.9	70.3	70.7	71.2	71.6	72.0	72.4	72.8	73.2	73.6
165	61.9	62.9	63.4	63.8	64.2	64.6	65.0	65.5	65.9	66.3	66.7	67.1	67.6	68.0	68.4	68.8	69.3	69.7	70.1	70.5	70.9	71.3	71.8	72.2	72.6	73.0	73.4	73.9	74.3
166	62.4	63.5	63.9	64.3	64.8	65.2	65.6	66.0	66.5	66.9	67.3	67.7	68.2	68.6	69.0	69.4	69.8	70.3	70.7	71.1	71.5	72.0	72.4	72.8	73.2	73.7	74.1	74.5	74.9
167	63.0	64.0	64.5	64.9	65.3	65.7	66.2	66.6	67.0	67.4	67.9	68.3	68.7	69.2	69.6	70.0	70.4	70.9	71.3	71.7	72.1	72.6	73.0	73.4	73.8	74.3	74.7	75.1	75.6
168	63.5	64.6	65.0	65.4	65.9	66.3	66.7	67.2	67.6	68.0	68.4	68.9	69.3	69.7	70.2	70.6	71.0	71.5	71.9	72.3	72.8	73.2	73.6	74.0	74.5	74.9	75.3	75.8	76.2
169	64.0	65.1	65.5	66.0	66.4	66.8	67.3	67.7	68.2	68.6	69.0	69.5	69.9	70.3	70.6	71.2	71.6	72.1	72.5	72.9	73.4	73.8	74.2	74.7	75.1	75.5	76.0	76.4	76.8
170	64.5	65.6	66.1	66.5	67.0	67.4	67.8	68.3	68.7	69.2	69.6	70.0	70.5	70.9	71.3	71.8	72.2	72.7	73.1	73.5	74.0	74.4	74.8	75.3	75.7	76.2	76.6	77.0	77.5
171	65.1	66.2	66.6	67.1	67.5	68.0	68.4	68.8	69.3	69.7	70.2	70.6	71.0	71.5	71.9	72.4	72.8	73.2	73.7	74.1	74.6	75.0	75.5	75.9	76.3	76.8	77.2	77.7	78.1
172	65.6	66.7	67.2	67.6	68.1	68.5	69.0	69.4	69.8	70.3	70.7	71.2	71.6	72.1	72.5	73.0	73.4	73.8	74.3	74.7	75.2	75.6	76.1	76.5	77.0	77.4	77.8	78.3	78.7
173	66.1	67.3	67.7	68.2	68.6	69.1	69.5	70.0	70.4	70.9	71.3	71.8	72.2	72.6	73.1	73.5	74.0	74.4	74.9	75.3	75.8	76.2	76.7	77.1	77.6	78.0	78.5	78.9	79.4
174	66.7	67.8	68.3	68.7	69.2	69.6	70.1	70.5	71.0	71.4	71.9	72.3	72.8	73.2	73.7	74.1	74.6	75.0	75.5	75.9	76.4	76.8	77.3	77.7	78.2	78.7	79.1	79.6	80.0
175	67.2	68.3	68.8	69.3	69.7	70.2	70.6	71.1	71.5	72.0	72.4	72.9	73.4	73.8	74.3	74.7	75.2	75.6	76.1	76.5	77.0	77.5	77.9	78.4	78.8	79.3	79.7	80.2	80.6
176	67.7	68.9	69.3	69.8	70.3	70.7	71.2	71.6	72.1	72.5	73.0	73.5	73.9	74.4	74.9	75.3	75.8	76.2	76.7	77.1	77.6	78.1	78.5	79.0	79.4	79.9	80.4	80.8	81.3
177	68.3	69.4	69.9	70.4	70.8	71.3	71.7	72.2	72.7	73.1	73.6	74.0	74.5	75.0	75.4	75.9	76.4	76.8	77.3	77.8	78.2	78.7	79.1	79.6	80.1	80.5	81.0	81.5	81.9
178	68.8	70.0	70.4	70.9	71.4	71.8	72.3	72.8	73.2	73.7	72.4	74.6	75.1	75.6	76.0	76.5	77.0	77.4	77.9	78.4	78.8	79.3	79.8	80.2	80.7	81.2	81.6	82.1	82.6
179	69.3	70.5	71.0	71.4	71.9	72.4	72.8	73.3	73.8	74.3	74.7	75.2	75.7	76.1	76.6	77.1	77.6	78.0	78.5	79.0	79.4	79.9	80.4	80.8	81.3	81.8	82.2	82.7	83.2
180	69.8	71.0	71.5	72.0	72.5	72.9	73.4	73.9	74.4	74.8	75.3	75.8	76.2	76.7	77.2	77.7	78.1	78.6	79.1	79.6	80.0	80.5	81.0	81.5	81.9	82.4	82.9	83.4	83.8

Source: Gueri M. et al. "Anthropometric assessment of nutritional status in pregnant women: a reference table of weight-for-height by week of pregnancy", The American Journal of Clinical Nutrition, Vol. 35, No. 3, 1982, pp. 609-611.

*A woman weighing less than 100% of the expected weight for height by week of pregnancy should be considered at risk of delivering a baby of unsatisfactory birth weight.

PREGNANCY WEIGHT GAIN GRID*



WEEKS OF PREGNANCY

*WEIGHT GAIN GRIDS SHOULD BE USED ONLY IN CONJUNCTION WITH A FOOD INTAKE ASSESSMENT .

APPENDIX E

INCORPORATING ETHNIC FOODS INTO CANADA'S FOOD GUIDE

FOOD GROUP	BRITISH COLUMBIA INDIAN	EAST INDIAN	CHINESE	JAPANESE	ITALIAN
MILK AND MILK PRODUCTS	Fluid milk Evaporated milk Fishbones used in soup and stews	Whole milk (more by men and children than by women) Buttermilk Commercial and home-made yogurt and cottage (Panier) Custard (Phirni) Kheer (rice pudding and nuts, noodles and milk, cream of wheat with milk and nuts).	Milk - especially flavoured (usually in small quantities until taste is developed) Custards Tofu	Milk - especially by the younger generations Yogurt Tofu	Fresh milk (by children) Cheese - hard and soft Most common are: parmesan romano, provolone, pecorino, gorgonzola, mozarella, ricotta (cottage cheese) Ice cream
MEAT AND ALTERNATES	Beef - ground Game (fresh, frozen, dried) - moose, deer, bear, beaver, grouse, ducks, geese, seal, sea lion, mountain goat Fish (fresh, frozen, dried, jarred and smoked) - salmon, cod, halibut, oolichans, octupus, crab, prawns, abalone, clams, cockles, mussels. Roe - herring and salmon Chicken Eggs, Peanut butter.	Many are vegetarian, esp. women Religion dictates type of meat eaten. e.g., Hindus and Sikhs eat lamb, goat, fish, pork. NO BEEF Muslims (Mohammedans) eat lamb, goat, beef, chicken and fish. NO PORK, and all meat is Kosher. Poultry, eggs Lentils (dal), Red beans (Raj Mahn), Chick peas (Chitte Chane), Black eyed kidney beans (Rongi) Small black beans (Mahn) Mung beans, Big brown beans (Kale Chane)	Pork, Beef Fish and shellfish Duck, Chicken, Organ meats Eggs Beans - soy, red, black and bean curd (Tofu) Split peas Nuts Pork sausage	Pork Beef Fish and shellfish, octupus Chicken Soya, soya cake bean curd (Tofu; red beans and Eggs Nuts	Beef, veal, lamb, pork, pork sausage, ham. Poultry - chicken, turkey, pheasant, partridge Rabbit Eggs Fish - bass, clams, crab, cod, eel, flounder, haddock, lobster, mackerel, salmon, shrimp, sole, tuna. Beans - lima, split peas, lentils, kidney beans, chick peas.
BREAD, CEREAL AND PASTAS	White bread, crackers Bannock (fried bread) White rice Macaroni (often packaged macaroni and cheese) Spaghetti Ready-to-eat breakfast cereal, oatmeal	Whole wheat pancakes (Roti) Commercial bread - white Ready-to-eat breakfast cereal (often eaten by children) Cooked whole-grain cereal occasionally Refined white rice Peaflour Graham flour (ground chana dal) Cornflour rotis	Rice, rice cakes, rice flour, rice noodles Millet Oats Wheat, noodles, macaroni Refined bread Buns - plain or or with meat and/or vegetable stuffing (sweet buns and cakes)	Rice, rice cakes Crackers Refined bread Noodles	Pasta - from wheat flour - 24 common varieties, e.g., noodles spaghetti, lasagna, ravioli. Rice (risotto) Bread and rolls - refined and whole wheat Baked products such as pizza crust, cakes, cookies, fruit breads.
VEGETABLES		The consumption of fruits and vegetables is extensive and varied and they are served at every meal, and as snacks. Vegetables are served both raw and cooked, often combined with other foods			
SOURCES OF VITAMIN A:	Carrots, canned ano fresh, tomatoes, fern shoots, new stinging nettle leaves. Canned peaches, apricots, Fresh fruit in season	Spinach, tomatoes, peas, broccoli, green beans, mustard greens (Rapini). Carrots, cantaloupe, pumpkin, mangoes.	Bok choy (Chinese mustard) and many other greens. Green peppers, tomatoes, carrots.	Sweet potatoes, spinach, carrots, tomatoes, yellow squash.	Asparagus, broccoli, carrots, escarole, green peppers, spinach, dandelions, tomatoes.
SOURCES OF VITAMIN C.	Potatoes, cabbage turnips. Canned and fresh tomatoes; oranges, rose hip syrup and jelly. Berries - soapallalie, elder, salmon, thimble, salal, buckle, blue, straw and raspberries	Citrus fruits and juices Cabbage, potatoes and tomatoes.	Bok choy, green peppers, tomatoes, tomatoes, water-cress, leafy greens, Chinese cabbage. Melons, oranges, papaya	Tomatoes, cooked and raw, cabbage and potatoes (in limited amounts). Oranges	Apricots, cantaloupe, peaches. Broccoli, cabbage, green peppers potatoes, tomatoes, Lemons, oranges, strawberries.
OTHER:	Canned corn and peas, onions. Chocolate lily and mariposa lily bulbs, sunflower roots. Salmon and thimbleberry shoots. Cow and parsnip stalks. Seaweeds	Onions, cauliflower, Frozen mixed vegetables.	Peas in pod, okra, celery, summer summer squash, green beans, white turnips. Mushrooms, eggplant Cucumbers, bamboo bamboo shoots, soybean sprouts	String beans, radishes, onions turnips, eggplant, cucumber, pickled vegetables, mushrooms, celery	Artichokes, cauliflower, celery, cucumbers, eggplant, green peas, lettuce, mushrooms, onions, stringbeans, turnips, zucchini.
	Canned cherries, fresh fruit in season				Apples, bananas, fresh figs, grapes.

SOURCE: B.C. DAIRY FOUNDATION 01/83 (used with permission)

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NUMBER

2

Preconception To Year One—Nutrition

Part II
Infant Nutrition

1984

Ministry of
Health

PRECONCEPTION TO YEAR ONE - NUTRITION

PART II - INFANT NUTRITION*

Nutrition Division

Ministry of Health

February, 1984

*Part I - PRECONCEPTION NUTRITION AND NUTRITION DURING PREGNANCY is also available from the Nutrition Division

PURPOSE OF THE MANUAL

This manual has been written to provide information on infant nutrition to physicians, nurses, dietitian/nutritionists and other health care professionals involved in counselling parents about feeding their babies. The manual contains information relevant to the healthy infant under one year of age.

It is recognized that in years past, babies have survived and thrived on a variety of different feeding regimens. The guidelines presented in this manual summarize the best current information on infant nutrition for the health professional who must provide leadership and guidance in this area. The guidelines, however, must not be construed as truth or certainty. Rather, they are a step closer to the truth. Further testing will lead us to more knowledge and perhaps whole new worlds, new theories and new assumptions where the old cannot be meaningful.

The manual is endorsed by the Nutrition Committee, British Columbia Medical Association.

The guidelines in this manual are also available in a summary format.

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PRECONCEPTION TO YEAR ONE - NUTRITION MANUAL

PART II

INFANT NUTRITION GUIDELINES

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CHAPTER I

BREAST-FEEDING

GUIDELINES AND SUMMARY

- *Infants should be breast-fed for six months or longer.*

- *Preparation for breast-feeding should begin early in pregnancy.*

- *Hospitals, the work place and society as a whole must be encouraged to establish climates which favour breast-feeding. For example, the practice of distributing formula samples ("gift pacs") to new mothers should be discontinued. Secondly, frequent breast-feeding on demand is recommended both as a means of ensuring adequate fluid intake for the newborn and to stimulate milk production. The routine use of glucose water is not encouraged.*

- *Caffeine intake in lactating women should be limited to less than 400 milligrams per day. Small amounts are excreted in the breast milk; infants cannot metabolize caffeine efficiently and it accumulates over time.*

- *If alcohol is consumed, it should be limited to one drink per day. Blood alcohol rises almost immediately after drinking and the alcohol content of breast milk is similar to the mother's blood alcohol level.*

- *Nursing women should not smoke, and infants should not be exposed to cigarette smoke. Cigarette smoking can reduce the amount of breast milk produced. Passive exposure to cigarette smoking is associated with an increased incidence of respiratory illness in infants.*

- *Given that a breast-feeding mother needs medication and that the hazards to the infant are believed to be minimal, a drug that produces the least amount in breast milk should be chosen.*

-###-

BENEFITS OF BREAST-FEEDING

Research on the composition of breast milk continues. As new vital elements are identified, manufacturers add them to their formulas. Some components of human milk may never be duplicated, for example: the immunological components; the changing composition from the beginning to the end of each feeding; and the altering composition paralleling the needs of the maturing infant (1).

Nutritional Bonuses of Breast Milk

- Sixty percent of the protein in human milk is whey - a protein that infants can digest more easily than casein, the major protein in cow's milk (2).
- Curds formed from human milk are small and soft, allowing optimal utilization of the protein by the baby (3).
- Lipids in human milk are rapidly absorbed (4), perhaps due to the presence of large amounts of lipases and unsaturated fatty acids in breast milk (2). In contrast, infants may find it difficult to digest the saturated butterfat in evaporated whole cow's milk formula before four to six months (5). This unabsorbed fat combines with calcium to form insoluble soaps in the gut, and leads to impaired absorption and frothy stools (6).
- Breast milk has a lower concentration of protein and minerals than cow's milk or commercial formula but the nutrients in breast milk are readily absorbed. The low concentrations of calories from protein, and minerals, ensures that no strain is placed on the infant's immature kidneys.
- The amino acid composition of human milk is recognized as ideal for the human infant. These characteristics are especially helpful to infants whose biochemical capabilities are underdeveloped at birth (7).
- Calcium and phosphorus are present in a ratio of two:one, allowing maximum absorption of both minerals (2).

- The concentration of iron is very low, but it is highly available to the infant. Forty-nine percent of the iron in breast milk is absorbed, while only ten percent of the iron in commercial infant formula is absorbed (8).
- Although breast milk and cow's milk both contain the sugar lactose, breast milk contains nearly fifty percent more (9). Lactose creates an acid environment in the gut which inhibits the growth of undesirable bacteria and improves mineral absorption. Lactose also acts as a laxative by maintaining sufficient fluid to soften the newborn's stools.
- The composition of breast milk changes during each feeding. During a feeding, the protein content of the milk doubles and the fat content increases five-fold (2). Fore milk provides fluid; hind milk satisfies the infant's appetite and may prevent over-feeding.
- Prior to birth, all infants receive some immunologic protection from their mother through the placenta. Breast milk contains many of these same factors which help to protect against infection.

  Secretory IgA, the predominant antibody in breast milk. It forms a protective paste-like coating along the intestinal epithelium and protects against the invasion of pathogenic bacteria and viruses. Infants do not produce their own IgA until six weeks to three months of age.

  Lactobacillus bifidus, an acid producing bacteria present in the intestinal flora of breast-fed infants. The acid environment promotes the growth of benign bacteria and discourages growth of harmful pathogens such as E. coli (10).

  Lysozyme, an anti-infective enzyme. It is present in breast milk in concentrations of up to 300 times that of cow's milk (11).

  Lactoferrin, an iron binding protein, protects against E. coli by binding the iron which E. coli requires for growth (11). Iron supplements saturate the lactoferrin and allow free iron to be available for E. coli growth (12). Lactoferrin does not inhibit absorption of iron by the infant.

Macrophage, a complex phagocyte which has been shown to produce complement, lysozyme and lactoferrin (13). Complement promotes opsinization, the rendering of bacteria and other cells susceptible to phagocytosis.

Lactoperoxidase, which has been shown in vitro to act with other substances in combatting streptococci (14).

- Human milk has a very low allergy potential in comparison to cow's milk and infants with a strong family history of allergy should be breast-fed whenever possible. Although the overall incidence of allergy may not be less in these infants, they may not be exposed to potential allergens as early. An older infant is better able to handle both potential allergens, and allergic reactions.
- Colostrum has been called "Drops of Gold" because it is so nutritious, rich in antibodies, and is a deep yellow colour. It has a slight laxative effect that clears and readies an infant's digestive tract (15).

Some Practical Bonuses

- Breast milk is clean, safe, and ready to use at the right temperature - day or night.
- Breast milk is economical. The extra food needed to supply the increased calories and nutrients necessary for milk production costs less than the bottles, nipples, sterilizing equipment, energy and formula needed for bottle feeding. Many mothers already have the calories and nutrients as a part of their diet.
- Breast-feeding helps return the mother to her pre-pregnancy weight. Of the 710 calories required per day for lactation, approximately 200 to 300 calories can come from the extra fat stored during pregnancy.
- Breast-feeding speeds up contraction and retraction of the mother's uterus. This contributes toward the mother re-gaining her pre-pregnancy shape.
- The infant's jaw development is promoted by the sucking action involved in breast-feeding.

- Nursing is emotionally satisfying for both mother and baby. Babies can nurse for comfort as well as nutrition. A tired cranky baby can cuddle in his mother's arms and nurse to sleep.
- Nursing is ecological and breast milk is a valuable natural resource.

PREPARATION FOR BREAST-FEEDING

Prenatal Preparation

Breast-feeding can be initiated with ease and can continue for many months especially if preparation begins early in pregnancy (16,17). Guidelines for instruction in prenatal preparation follow.

- Parents' values and beliefs about breast-feeding may strongly influence their decision to breast-feed and how long they continue. Support the parents' ultimate decision regarding feeding method, but encourage breast-feeding early in the prenatal period.
- Inform mothers, who plan to return to work, of the benefits of breast-feeding even for a few months; and that in many cases it is possible to continue breast-feeding even after returning to work.
- Encourage adequate weight gain during pregnancy. Part of the maternal energy stores are used for milk production.
- Encourage attendance at prenatal classes and/or breast-feeding classes where future parents are taught what to expect in the breast-feeding experience.
- Recommend books future parents can read both before their baby's birth and use for reference postpartum. Suggestions are included on page 39.
- A health professional should examine the woman's breasts to assess whether or not the nipples are tractile. The infant must be able to draw the nipple up against the palate when sucking. Early detection and intervention of nipple flatness or inversion will prevent subsequent feeding problems and the emotional stress that ensues.

- True inverted nipples are rare, but special breast shields and exercises should alleviate the problem. The shields apply gentle pressure around the nipples and encourage them to become erect. Breast shields are available in drugstores.

The following hints for using breast shields for inverted nipples may be helpful (18).

> Breast shields are worn inside the bra for increasing lengths of time, beginning in the third trimester.
>
> Plastic or glass shields are preferred; rubber shields pull on the skin and hold in the moisture.
>
> A larger bra may be needed to accomodate the shields.
>
> Shields should not be worn when sleeping because inappropriate pressure may damage delicate breast tissue.
>
> Shields may be worn post-natally for half an hour to one hour before feeding the baby.

- Nipples that are small or flat with only a slight inversion are much more common and easier to correct than true inverted nipples. The Hoffman Technique is recommended (18). Instruct the mother to: position her thumbs opposite each other on the areola, then gently stretch the nipple skin by drawing the thumbs farther away from the base of the nipple; reposition her thumbs and repeat.

- Nipple preparation is recommended for all mothers. The following exercises are recommended.

  Support breast gently with fingers while grasping the nipple with thumb and index finger. Gently roll the nipple between thumb and index finger.

  An effective and pleasant method sometimes overlooked is oral and manual stimulation of the nipples by the woman's partner.

  Moderate exposure of the breasts to air is helpful. A mother wearing a nursing bra can let the flaps down under her garment or not wear a bra. Exposure to sun is often contraindicated as sun rash can result.

  Wash nipples with water only. Soap dries the nipples and may result in cracking.

In the Hospital

- Infants whose mothers receive large amounts of anesthesia during childbirth suck poorly and these effects may endure throughout the nursery stay (19). Poor sucking leads to both poor milk production and poor let-down.

- It is desirable to encourage the first feeding within a half hour after birth (20, 21). The sucking reflex is strongest 20 to 30 minutes after birth; if the infant is not fed at this time, the vigorous sucking reflex diminishes and does not return until the end of the second day of life (21). Early sucking also helps to prevent post-partum hemorrhage (19).

- Breast milk is readily digested. A nursing infant should be fed at least every three hours including night feedings (19). Hospitals should adjust their feeding schedules to prevent hungry breast-fed infants from crying to exhaustion. Healthy infants should be allowed to stay with mothers during the night. A sleepy infant who is too exhausted to suck will not help a mother who is worried, frustrated and too anxious to nurse.

- Mothers should nurse for at least five minutes. Nursing only a minute or two on each breast during the first few days delays rather than eliminates nipple discomfort (19, 22). It may take two to three minutes for milk to let-down. If a new mother is limited to only a few minutes, she will not develop a well-timed, efficient and conditioned let-down.
  A breast can be emptied in five to ten minutes. It is not necessary to prolong a feeding beyond this time if nipples are tender. Switching breasts every three to four minutes may be more comfortable, as long as the infant is properly detached each time.

- The Ministry of Health supports the World Health Organization International Code for Marketing of Breastmilk Substitutes which encourages breast milk as the safest and preferred food for infants and discourages distribution of free product samples.
  Distribution of formula samples by public health staff was discontinued a number of years ago, but some hospitals have continued to give out "gift pacs" to all new mothers. This practice is not supportive of breast-feeding and should be discontinued. Parents given samples change from breast-feeding to formula earlier than those not given samples (23). Furthermore, where there is a language barrier, or a poor understanding of nutrition, education in formula preparation more thorough than label directions is required.

- Adequate fluid intake is important as it may help prevent physiologic jaundice in a newborn. Frequent breast-feeding should be encouraged rather than provision of glucose water, to enhance a mother's milk supply and provide more fluid to promote the excretion of bilirubin.

In addition, colostrum speeds the passage of meconium, a baby's first stool, which is laden with bilirubin (15).

Routine use of glucose water for hydration is not recommended. Regular intake deprives the infant access to valuable colostrum and the calories from glucose water may start a chain reaction: appetite satiation - decreased desire to suck - decreased breast stimulation - less milk produced - increased maternal anxiety. Sterile water should be given to a breast-fed infant for routine hydration, not glucose water.

DIET

When a woman is breast-feeding, her need for energy and for almost all nutrients is increased (see Table I). Food needs for lactation are outlined in Canada's Food Guide. Vitamin-mineral supplements are not recommended unless the need is established and cannot be corrected with food. Moderate or severe caloric restriction decreases milk production, so reducing diets are discouraged while a woman is breast-feeding. Physicians may refer a woman to a dietitian/nutritionist for assessment and counselling.

Factors Influencing Nutritional Needs for Breast-feeding

A number of factors influence the dietary needs of the breast-feeding woman (24).

The process of synthesis of milk components requires additional nutrients and energy.

The woman's efficiency in converting dietary intake to milk nutrients will influence needs.

The volume of milk increases from the newborn period to at least the sixth month. Some nutrients may be drawn from maternal tissues, so storage and availability of energy and nutrients is a consideration.

> Adaptation to low levels of nutrients and energy does occur as seen in developing countries. It may involve greater efficiency in absorption and utilization, depletion of body stores, low maternal physical activity, lower volume of milk production and limitation of infant growth. The physiological costs of such adaptation to the woman and her baby are difficult to estimate.

Much more remains to be understood about nutritional requirements of breast-feeding women. The current Recommended Nutrient Intakes (Table I) are the best estimates of average need at this time (25).

How Requirements are Estimated

Breast-feeding requirements are determined by: estimating the volume and nutrient content of the milk produced; adding the physiological needs of the mother for synthesis of the milk components; and taking into account efficiency of absorption and milk production.

Translating the Recommended Nutrient Intakes into Food Needs

The caloric requirements for lactation are approximately 450 kilocalories, only 150 kilocalories above the energy need during the second and third trimesters of pregnancy. The normal weight, well nourished woman should follow Canada's Food Guide and select at least the following number of servings from these categories. These foods provide a nutritional foundation and supply approximately 1400 kilocalories. Additional servings are needed to meet energy needs. Generous amounts of fluids are essential. The underweight or undernourished woman may need a referral to a dietitian/nutritionist for assessment and counselling.

TABLE 1

RECOMMENDED DAILY NUTRIENT INTAKES (1983) FOR NON PREGNANT AND LACTATING WOMEN

Age/Years	Kilocalories per Kilogram[a]	Protein Grams per Kilogram IBW*	Vitamin A RE[b] per day	Vitamin D ug cholecalciferol[c] per day	Vitamin E mg[d] per day	Vitamin C mg per day	Folacin ug per day	Vitamin B 12 ug per day	Thiamin mg per 1000 Kcal[e]	Riboflavin mg per 1000 Kcal	Niacin NE[f] per 1000 Kcal	Pyridoxine (B_6) mg per gram protein	Calcium mg per day	Magnesium mg per day	Iron mg per day	Iodine ug per day	Zinc mg per day
Non-Pregnant																	
13-15	46	89	800	2.5	7	45	160	1.5	4	5	7.2	015	800	190	13	160	8
16-18	40	81	800	2.5	7	45	160	1.9	4	5	7.2	015	700	220	14	160	8
19-24	36	74	800	2.5	7	45	165	2.0	4	5	7.2	015	700	190	14	160	8
25-49	32	74	800	2.5	6	45	165	2.0	4	5	7.2	015	700	190	14	160	8
Additional Needs for Lactation	+450 Kcal	+20 g	+400 RE	+2.5 ug	+3 mg	+30 mg	+120 ug	+.5 ug	+.18 mg	+.4 mg	no increase	+.3 mg	+500 mg	+80 mg	no increase	+50 ug	+6 mg

* **Ideal Body Weight**

a. These figures are averages. Actual requirement varies within a range of ± 30% of these figures. 1 kilocalorie (calorie) = 4.18 kilojoules.

b. 1 RE (retinol equivalent) corresponds to 1 ug retinol, 6 ug B-carotene or 12 ug of other carotenes. In a mixed diet of plant and animal vitamin A sources, multiply RE value by 5 to convert to I.U.'s

c. 1 ug cholecalciferol is equivalent to 1 ug ergocalciferol (40 I.U. vitamin D). 5 ug cholecalciferol = 200 I.U.

d. To approximate the number of I.U.'S, multiply the number of milligrams of vitamin E by 1.49.

e. Intake for those 19 years and over should not be less than 8 mg per day.

f. 1 NE (niacin equivalent) is equal to 1 mg of niacin or 60 mg of tryptophan.

Food Planning for Lactation

Milk and Milk Products	4 servings
Fruits and Vegetables	5 servings
Breads and Cereals (Grains)	5 servings
Meats, Fish, Poultry, Alternates	2 servings
Fluids	very frequently

Dieting

Approximately two to four kilograms of fat are stored during pregnancy in preparation for lactation. These stores are used for energy during lactation at a rate of approximately 300 kilocalories per day for three to four months (26). For many women, however, a slow rate of weight loss after childbirth does not satisfy their desires to return quickly to pre-pregnancy weight. Moderate to severe caloric restriction will compromise the woman's ability to synthesize milk. For this reason, it is not recommended (27). If after stopping breast-feeding, a woman has not reached her pre-pregnancy weight, diet counselling by a dietitian/nutritionist may be advised.

Exercise

A physical activity program may be resumed four to six weeks after childbirth. Care must be taken to replace fluid lost during activity so as not to compromise the milk supply. To calculate the amount of fluid to be replaced, follow the formula on page 13.

HOW MUCH FLUID TO REPLACE?

A = B - C

A = weight lost in water to be replaced before further activity
B = weight before activity
C = weight after activity

For every pound lost, drink 16 ounces of fluid. Water and fruit juice are recommended.

Maternal Supplements

Maternal supplements are only advised where there is a documented need. Even then, food sources of nutrients are recommended over vitamin-mineral supplements. The Recommended Nutrient Intakes which appear in Table I should be used as a guideline for estimating amounts required.

In certain situations a supplement may be prudent. For example, a woman who cannot tolerate milk products and whose dietary intake is inadequate in alternate sources of calcium may require a calcium supplement to meet the lactation calcium requirement of 1200 milligrams. If the climate is not sunny, or if it is winter, she may also require a vitamin D supplement of 5 ug (200 International Units).

Prenatal-type supplements will not change the vitamin content of breast milk in well nourished women and may be continued until the bottle is finished. Mega doses of any vitamins, however, are not recommended. Elevated serum vitamin A levels were reported in a mother and her premature infant who was fed only breast milk while the mother took 40,000 International Units of vitamin A per day (28).

It has been reported in the literature that pyridoxine (vitamin B_6) blocks lactation. This is a matter of concern because most of the prenatal and other multivitamin preparations now available contain vitamin B_6. It is thought that pyridoxine inhibits the secretion of breast milk in nursing mothers by suppressing the prolactin levels (29,30). The level of pyridoxine used, however, was approximately 200 times more than the recommended intake for lactating women (30).

Foods to Avoid

There is no basis for avoiding garlic, curry, shellfish or any other food simply because a woman is breast-feeding, although some foods may flavour the milk and make it unappealing to a particular baby.

Similarly, there is no one food which must be eaten to ensure successful lactation.

SUCCESSFUL BREAST-FEEDING

Techniques

The following guidelines are appropriate for use by the health professional in counselling the breast-feeding mother.

1. Be comfortable. If you have had an episiotomy or operative delivery you may prefer to breast-feed lying down. Position yourself comfortably on your side, using pillows for support as required. The baby should be placed on his side with his mouth parallel to your nipple (Figure 1.1). At first you may both need help in repositioning to feed from the other breast.

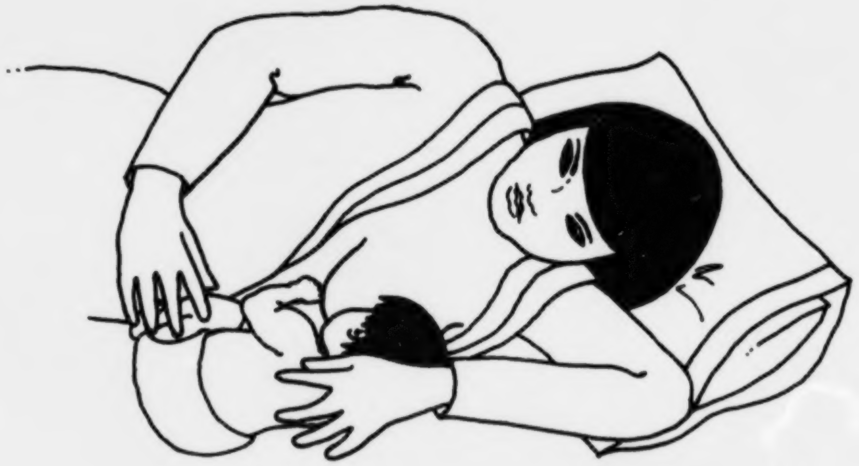

Figure 1.1. Recommended Recumbent Position for Breast-Feeding.

This position may be reversed so that the infant's feet are toward your head (Figure 1.2). This allows for different areas of the nipple to be stimulated and affords relief if nipples are tender.

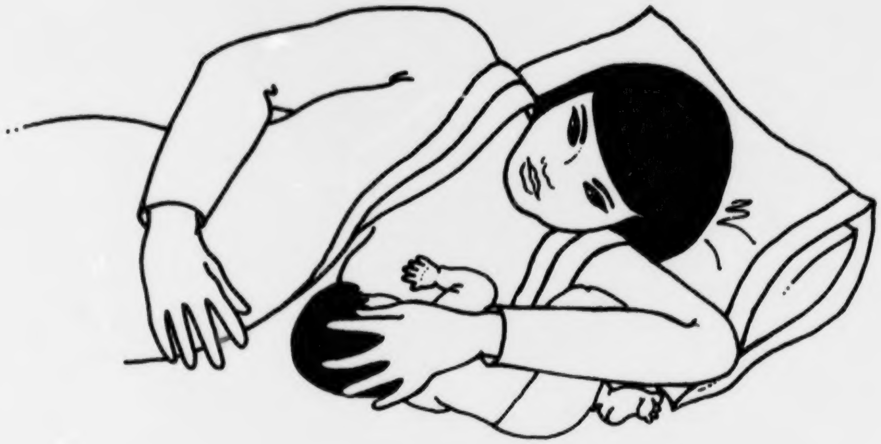

Figure 1.2. An Alternative Recumbent Position for Breast-Feeding.

Another successful position involves sitting in a comfortable chair that provides good back support, arm rests, and, if possible, foot and leg support. Cradle your baby in your arm with his head placed over your elbow so that his mouth is adjacent to the nipple. You may find a pillow on your lap will support the weight of your baby and your arm will not get tired.

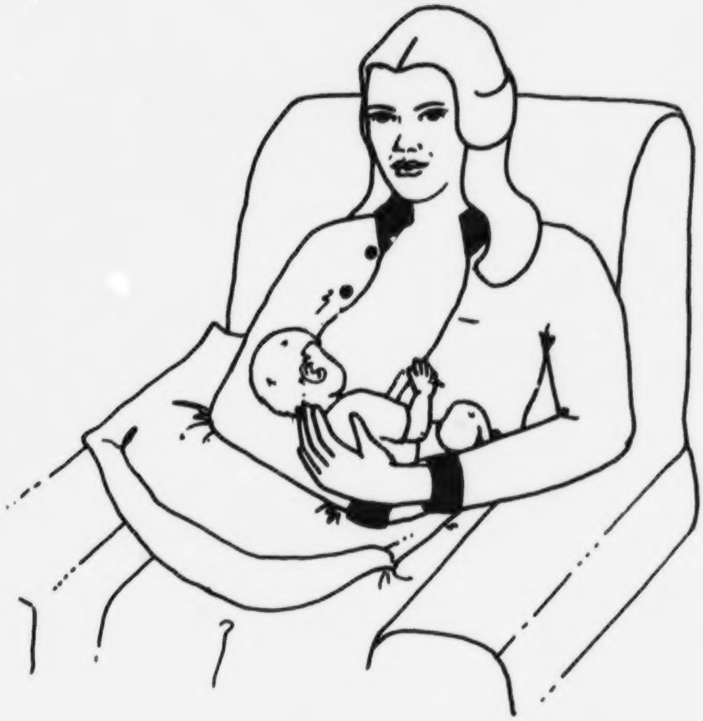

Figure 1.3. Breast-Feeding While Sitting in a Comfortable Chair.

The "football hold" is especially comfortable if you have had a cesarean delivery. The baby's head is held in the palm of your hand while the forearm is used to support his torso (Figure 1.4). This allows you to move your baby easily until he is properly positioned on the nipple.

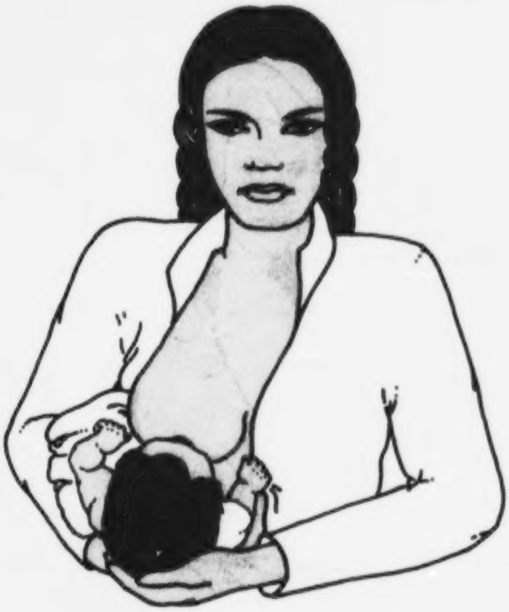

Figure 1.4. Baby Is Tucked Under the Right Arm Like a Football And Is Nursing on the Right Breast.

2. Burp your baby before feeding, between breasts, and after feeding. Incomplete burping can result in spitting-up or even throwing up what seems to be an entire feeding. To burp, gently but firmly pat or rub the baby's back, at the shoulder blade area. A small towel under his mouth for spit-ups will save your clothes. Holding the baby upright for short periods, interspersed with nursing, also works well.

3. Be sure nipples are erect; stimulate them if necessary. If the breast is very full, causing the nipple to be flattened with milk, the areola can be softened, and the nipple will become erect, by manually expressing a little milk. Moist heat and massage to the breast before expression and feeding may be helpful. Positioning the baby under the breast so the nipple can "hang" in the mouth helps too. The football hold (Figure 1.4) accomplishes this for many mothers.

4. Express some milk onto the nipple so the taste will entice the baby.

5. Grasp the areola lightly between the forefinger and middle finger of the free hand and flatten it slightly to correspond with the oval shape of the infant's mouth.

6. Make use of the rooting reflex which causes the baby to turn his face toward the stimulated cheek. Stroking the baby's left cheek will cause him to turn his face to the left. Thus if you stroke the baby's cheek nearest the nipple, the baby will respond by turning toward your breast.

7. When the baby's mouth is open wide with tongue down, promptly move the baby well onto the nipple and areola. Be sure that the baby's tongue is down (under the nipple) and that the baby's mouth almost completely encompasses the areola. Many mothers do not realize how much of the breast must be in the mouth to prevent soreness. (Of course, some women have very large areolas and this may not be possible.) The secret is to wait for the wide open mouth. If the baby has difficulty

opening his mouth wide enough, touch his chin in the midline and press down. This avoids stimulating a frustrated rooting response.

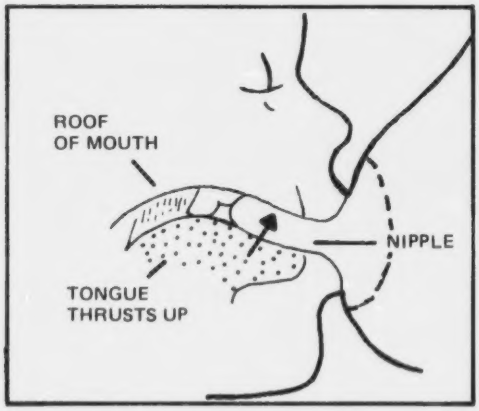

Figure 1.5. Proper Nursing Position. Make sure the baby's tongue is down (31).

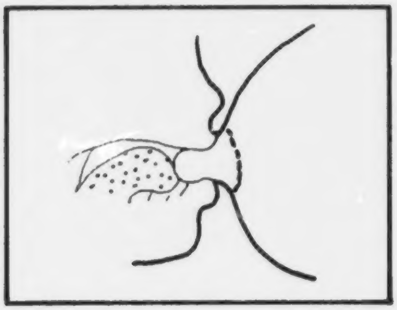

Figure 1.6. Poor Nursing Position. This occurs when the baby is allowed to nuzzle at the breast and work his way on to the nipple. The baby is sucking on the tip which will result in sore, cracked nipples, poor milk production and a hungry, fussy baby (31).

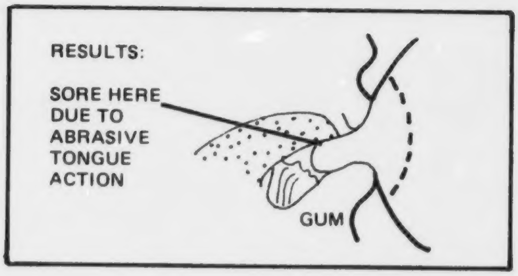

Figure 1.7. Poor Nursing Position. Results in sore nipples due to the abrasive tongue action and the lower gum "pinching" the nipple. No milk for baby (31).

8. Watch your baby nurse. Observe the pump-swallow-breathe pattern. Productive breast-feeding is characterized by a long, rhythmic pump-swallow action, not by short, choppy jaw movements. Look and listen for swallowing so that you know your baby is actually nursing and not just pacifying at the breast. One indication that a baby is swallowing properly is that his ears will wiggle.

9. Ten to fifteen minutes of nursing on each breast by the end of the first week is a reasonable amount of time.

10. It is usually advisable to nurse on both breasts at each feeding. This ensures uniform filling and avoids engorgement. Some mothers find that their baby nurses more frequently at certain times during the day. At these times, one breast may be sufficient, giving a longer rest to tender nipples. Some mothers may find their breasts adjust to only using one breast at a feeding. It is also normal for babies (and mothers) to choose one breast as a favourite and find that it produces more efficiently.

11. Break suction properly! Insert a finger between the baby's gums to properly break suction. Simply putting a finger in the corner of the baby's mouth can lead to sore, traumatized nipples.

12. Start the next feeding on the breast on which your baby was last fed. The first breast used in nursing is usually emptied more completely than the second.

Common Concerns About Breast-feeding

With early discharge policies concerns may arise once a woman is at home. She should be instructed to contact the public health nurse in her local health unit or La Leche League (local chapters are listed in the telephone book).

1. Concern over the quality of breast milk.

True milk comes in anytime from the second to the sixth day. At first there is still some colostrum mixed with it, making it "creamy" looking. Later, as lactation becomes established, the colostrum disappears, and the milk appears thin and watery. All of the components of human milk, however, have unique advantages for the infant.

Breast milk changes in composition over the course of a single feeding. In the first part of feeding breast milk often appears thin and bluish-looking. Richer, creamier milk comes in at the end. Women may think their milk is of poor quality because of this and may decide to supplement or wean - an unnecessary and often traumatic decision.

2. The let-down reflex does not occur readily.

The let-down reflex is the physiological reaction that causes milk to be ejected from the breast. Sucking at the breast stimulates release of the hormone oxytocin, which stimulates the flow of milk. It may cause a tingling sensation in the breasts.

This reaction evolves over a period of time, but it may be several weeks before it becomes consistent. As the initial tenderness and swelling decreases and mother and infant become more experienced, the let-down reflex will begin to occur automatically soon after the infant is put to the breast.

The let-down reflex is sensitive to a mother's mood. Stress, embarrassment or anxiety can inhibit the reflex. Nature may require some help. When milk does not let-down, apply heat to the breasts for at least ten to fifteen minutes, in a bath or shower, or using a hot water bottle or heating pad.

3. Concern over the quantity of breast milk

Unnecessary concern over quantity of milk may arise from inaccurate information. All breast-feeding mothers should be aware that:

- the breast-fed baby is hungry more often than a bottle-fed baby for two reasons. First, human milk is easily digested; second, a breast-fed baby may consume less at a feeding than a bottle-fed baby. Feeding frequently is normal and necessary - it helps to build up milk supply.

- growth spurts can occur several times during the first few months, typically around two weeks, six weeks, and three months. During these times, the baby may want to feed as often as every hour for several days. This does not mean the mother has lost her milk but rather that the baby now needs more and is building it up by more frequent nursings. Mothers should be encouraged to rest, feed their baby on demand, and not supplement with formula.

- disappearance of a feeling of fullness in the breasts is also normal several weeks after birth. It does not signal the loss of milk.

2

- once established, milk production and breast-feeding seems effortless, as long as the mother is rested and drinks plenty of fluids. This is a sign of successful breast-feeding not failure.

- two indicators that the baby is receiving enough breast milk are: six to eight wet diapers a day (assuming the baby is getting no additional water or formula). Disposable diapers draw the wetness away from the baby and deep into the diaper. Mothers should poke a hole in the plastic backing of the diaper when they remove it to check for wetness.
  adequate growth: 180 to 240 grams per week or 30 grams per day during the first three months. A post-partum weight check on an accurate scale is recommended by seven to ten days to establish adequacy of weight gain. It is not a good idea for the mother to weigh her baby at home after feedings. Home scales are inaccurate and their use can discourage the mother and undermine successful breast-feeding.

- the mother should not be told that a satisfied baby is a well fed baby. Some babies do not protest even when under fed. On the other hand, fussiness does not always indicate hunger. Wet diapers and weight gain are the indicators to use, not seeming satisfaction (32).

4. Sore nipples

The following suggestions should help a mother with sore nipples.

- Ensure that correct breast-feeding techniques are being used.
- Keep feedings short (seven to ten minutes per side) and frequent. Frequent feedings prevent aggressive nursing and more soreness.
- Begin a feeding by uncovering both breasts. Start the baby on the less sore side. When let-down has occurred on the more sore side, switch the baby to that side and nurse seven to ten minutes. Then switch back to the less sore side and finish the feeding.

- Experiment with different nursing positions. A mother may sit upright at one nursing and lie down at the following; or she may cradle the baby in her arms at some feedings and use the "football hold" at others. These changes may offer some relief to sore cracked nipples.
- Be sure the nipples are naturally air-dryed before they are covered.
- Avoid soaps and alcohol on the nipples. Gently apply Masse, lanolin or expressed breast milk to dry nipples. Do not wash off even before nursing.
- Some women find exposing their nipples to heat and light from a lamp helpful (45 centimetres (18 inches) from a 25 to 40 watt bulb, 15 to 20 minutes, two to three times per day (33)).

5. Engorgement

Engorged breasts are heavy, full of milk, and painful, caused by congestion of fluid in the breasts. If the condition is not relieved severe pain will result. Primary engorgement is due to poor circulation of blood and lymphatic vessels plus a build-up of breast milk (31).

Many hospitals now have early discharge policies. Breast-feeding mothers go home before their milk supply is well established and thus before engorgement can develop. It is vital to teach breast-feeding mothers how to prevent engorgement and how to manage it if it does occur. To prevent engorgement, first, breast-feeding should begin as soon as possible after delivery and occur frequently (i.e. every two to four hours including night feeds). Second, the mother should wear a cotton bra with good support and stimulate breast circulation by applying moist heat to breasts and circling her arms, and doing shoulder rolls. To manage engorgement the mother should: nurse often, at least every two to three hours during engorgement (27); apply moist heat to breasts (i.e. a soak in the bath tub, a gentle shower or, warm, wet face cloth); gently massage breasts; express milk for comfort and to make the nipple erect so that the baby can get on the areola well (see page 27 for manual expression technique). Breast pumps may be preferred by some women, particularly when breasts are severely engorged (see page 27 for information on breast pumps).

6. Leaking

Some women find that just thinking about feeding the baby or hearing a cry will start milk dripping from their breasts. Leaking can be stopped by pressing hard against the nipples with the palms of the hands until the tingling stops. Clothing can be protected by placing a cotton pad or handkerchief inside the nursing brassiere. Pads should be changed when they become damp. If allowed to dry, they may stick to the nipple and pulling them away can cause nipple damage. If sticking should occur, soak the area with water before removing. Avoid pads or bras with plastic backing; they prevent air from circulating around the nipple causing sore nipples.

7. When mother is sick

It is not necessary to discontinue nursing for minor illnesses such as a cold or the flu. The infant has usually been exposed to the infection by the time the mother develops symptoms.

8. Manual expression of milk

Many mothers find manual expression of milk a very useful technique to learn. First, it provides a milk bank, allowing someone else to feed the baby occasionally. Second, if engorgement occurs, milk can be expressed for comfort.

To express milk manually:

- wash hands thoroughly.
- apply moist heat to the breast and massage gently.
- place the thumb above and forefinger below the breast at the edge of the areola.
- squeeze in a "milking" motion, gently but firmly pushing the thumb and fingers back toward the chest.
- continue by rotating the grasp around the breast to reach all the milk ducts that radiate out from the nipple toward the back of the breast.
- sliding or rolling the hand across the breast tissue is not only ineffective but also painful. This is a heavily veined area and the breast could be bruised if engorged.
- express from one breast for three to five minutes and then switch breasts. Each breast should be expressed twice.
- express milk into a clean bottle and refrigerate or freeze at once.

9. Using a breast pump

Occasionally a nursing mother may be separated from her baby for some reason and may choose to use a breast pump to express milk. Some general considerations are:

- no pump completely empties the breasts. Pumping draws milk which is stored in the lower ductal areas under the areola.
- pumping may increase a mother's supply, but it is more likely to help her maintain a supply until the baby is able to nurse directly.
- a mother should pump on a schedule similar to the timing of regular nursings.
- there is little relationship between the amount of milk produced and the amount of milk the mother may pump out. First efforts usually yield very little. With practice, pumping the breasts becomes more natural, and a larger supply can be obtained.
- unless the separation is longer than one week, a breast pump may be unnecessary. Most short-term separations can be handled through manual expression.

- the decision to use an electric versus manual pump need not be based on expense. Although manual pumps are less expensive to purchase, many cities have rental sources of electric pumps.

10. Storing expressed breast milk (34)

- Use jars that are of a convenient size, or previously unused plastic freezer bags.
- Sanitize jars, lids, containers for milk collection and breast pump (see pages 69 to 70). Microwave ovens will not sterilize equipment.
- Express milk into a freshly sanitized container.
- Cover and refrigerate the milk immediately. Milk may be stored for 24 hours in the refrigerator, two weeks in the freezer compartment of the refrigerator, or up to six months in a -18 degree Celsius deep freeze (35).
- Milk can be frozen in layers. Add cooled milk to a bottle in which there is a portion previously frozen.
- Milk should be thawed slowly; a pan of warm water works well. Excessive heat may coagulate the protein.
- Milk may be thawed and warmed in a microwave oven, according to the manufacturer's instructions. Reusable glass bottles should be used, not plastic ones for two reasons. First, some plastics contain polyvinyl chloride (PVC), polystyrene or melamine resins. Heating foods contained in these plastics may cause potentially poisonous materials to leak into the food, even at temperatures as low as 60 degrees Celsius (36). Second, disposable plastic bags might split and spill hot milk on the baby.
- The time required to warm milk in the microwave is extremely brief (approximately 10 seconds). There is a danger of overheating which will denature the protein and reduce its digestibility. Milk continues to cook once it is removed from the microwave. It may also heat unevenly resulting in hot spots. For best results, rotate the

bottle, swirling the contents and then let the milk stand for a few minutes before serving. Bottles should not have the caps or nipples on when being warmed.

11. Allergy to breast milk

An allergy to breast milk is very uncommon. Occasionally, allergic reactions may be triggered by something in the mother's diet. It takes four to six hours for food components or metabolites to appear in breast milk (37). If an infant shows allergy symptoms, a mother's diet should be carefully recorded to identify and then reduce or eliminate the offending food. At a later date the food should be re-introduced and the effects monitored.

12. Weaning

To wean initially eliminate one breast-feeding a day and substitute either whole milk or infant formula (the choice being dependent on the infant's age, see Chapter II). After several days eliminate another breast-feeding, again supplementing with formula or whole milk. Gradually reduce the breast-feedings to one per day and then begin nursing just enough to remove the sensation of fullness. After a week of one feeding per day, skip days and nurse only when breasts are uncomfortably full. By this time milk production will have dropped off markedly and complete cessation will not be uncomfortable.

Babies usually accept the change better if they are not rushed, particularly if they are teething or not feeling well.

Cow's milk is a known allergen for many babies; unusual symptoms (diarrhea, constipation, excessive spitting up, coughing or a rash) should be noted. If necessary breast-feeding can be re-established.

THE BABY AND BREAST-FEEDING

Bowel Movements

The completely breast-fed baby rarely gets constipated. Stools often range from a coloured fluid with curdles or seed-like particles to a mustard consistency. It is sometimes just a stain on the diaper and varies in colour. Initially a baby's stool is very volatile, very explosive, loose, runny and watery. Between one and two months, bowel patterns change to stool infrequency, ranging from once every three to seven days. Babies are often very fretful and fussy until they accommodate to this new pattern.

Supplemental Feedings

It is wise to introduce babies to an occasional bottle once breast-feeding is established. Then, if a situation arises where the baby must receive nourishment from a bottle, he will not reject the bottle.

The Dental Health Division, British Columbia Ministry of Health, recommends orthodontic nipples; they more closely resemble the shape of the mother's nipple and elicit the same pump-breathe-swallow action required when an infant nurses at the breast. The nipple should be soft enough to flatten out against the roof of the baby's mouth during sucking (Figure 1.8). A relatively inflexible nipple may keep the tongue from its usual rhythmical action and only confuses the infant.

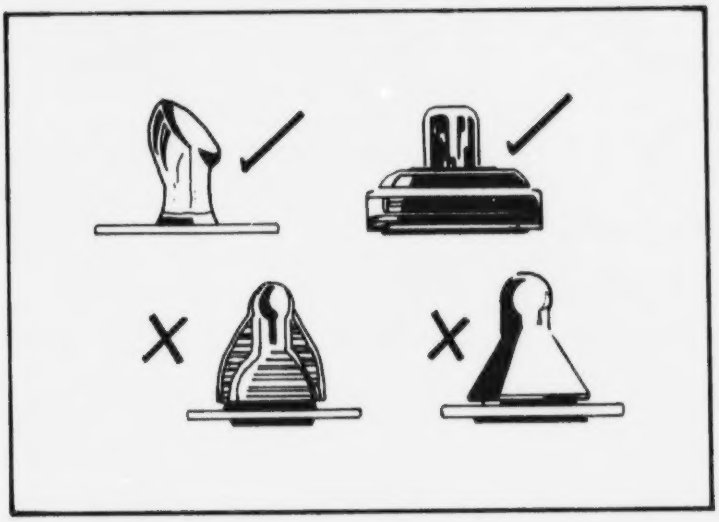

Fig. 1.8: Recommended And Non-Recommended Nipples (38)

A Sick Infant

Infants with minor illnesses do best if breast-feeding is continued (39). Breast milk offers protection against many mild infections and speeds recovery. A baby with a cold may find it difficult to breathe and suck at the same time. Suggestions include short frequent feedings, a more upright position for the baby while nursing, a steamer in the room, nose drops or normal saline drops. If the infant is too weak to suckle, parents should consult their physician.

When a sick baby is hospitalized, arrangements can be made for a mother to nurse on a regular schedule. If this is not possible, a mother should express her milk frequently. If saved it can be fed by the nursing staff or be stored for use later. Supply may decrease but once the hospitalized baby is able to nurse, it will increase.

SPECIAL CONSIDERATIONS

Premature Babies

Tips from an experienced mother on breast-feeding the premature infant are presented by Silver (40). The basic recommendations provided in this publication are included below.

Breast-feeding the Premature Infant

- Express your milk as soon as possible after giving birth; avoid "drying up" pills, birth control pills, and any other hormonal medication.
- As soon as the doctor will allow it, try to breast-feed your baby.
- Establish close (skin-to-skin) contact with the baby, especially prior to feeding.
- Eat a well balanced diet at all times and drink lots of fluid.
- After bringing the baby home, plan to spend the first few days in bed with the baby in a relaxed setting.
- If breast-feeding was not well established in the hospital and a formula supplement is necessary, stimulate milk production by nursing first. Keep track of how much formula the baby takes after nursing. When this amount begins decreasing, give the bottle after every other nursing, then after every third, and so on until the bottle is eliminated altogether. Wean the baby from the bottle as soon as possible.
- If, for some reason, you absolutely can't nurse, don't worry. What the child requires if it is to prosper, is to be handled and carried and caressed and cuddled and cooed to, even if it isn't breast-fed.
- For information on general techniques for successful breastfeeding see pages 14 to 22.

Nursing a Baby Delivered by Cesarian Section

A mother who has delivered by cesarian section and plans to breast-feed can do so as soon as the effect of the anesthesia wears off. Any pain medication should be short-acting and given immediately before breast-feeding.

Help in positioning may be necessary for comfortable nursing. Many women find that nursing while lying down is most comfortable, especially during the first few days. Other mothers recommend nursing while sitting tailor-fashion (cross-legged), with pillows on their knees to support their babies.

Subsequent Pregnancy

Pregnancy can and does occur while breast-feeding. However, a growing fetus and nursing infant both place nutritional demands on the mother. The decision to continue breast-feeding must take into account a mother's ability to get enough rest and nourishment - enough to satisfy the requirements of both pregnancy and lactation. If this is not possible, a mother would be wise to gradually wean the older infant during the subsequent pregnancy.

LIFESTYLE CHOICES

Working Mothers

Many mothers continue to nurse after returning to full-time jobs, although it involves considerable organization and planning. The following strategies have been successful (41).

- Going home, or having the baby brought to work, for feedings.
- Expressing milk at missed feedings to be given to the baby the next day.

- Providing a formula supplement for the feedings missed during the workday, and breast-feeding before and after work.
- Providing the babysitter with an emergency supply of formula.

The transition back to work will be less stressful if both mother and baby are prepared.

- The babysitting arrangements should be successfully established before returning to work to ensure that they are satisfactory.
- If a bottle or cup is to be used for feeding, the baby should be used to it.
- If the baby is being weaned from some feedings, the new feeding routine should be introduced gradually and well established before returning to work.

Drugs

Drugs appear in breast milk at only one to two percent of the initial dose, but this may be harmful to the infant (42). Additional factors must also be considered when dealing with specific drugs. Tetracycline, for example, may interact with calcium and proteins in breast milk, resulting in minimal or no absorption by the infant (43).

Given that a mother needs a specific medication, that the hazards to the infant are believed to be minimal and that the following precautions are observed, breast-feeding can continue (44).

- Choose the drug that produces the least amount in the milk.*
- When possible prescribe a short-acting form of the drug. The infant has difficulty in excreting long-acting agents requiring detoxification in the liver and accumulation is a possibility.

*Refer to American Academy of Pediatrics Committee on Drugs, "The transfer of drugs and other chemicals into human breast milk"(Pediatrics, Vol. 72, No. 3, 1983) pp. 375-383; and R. Lawrence, Breast-feeding: A Guide for the Medical Profession (The C.V. Mosby Co., Toronto, 1980), pp. 315-336.

- Consider the absorption rate and peak blood level of the drug and plan a dose schedule with the mother so that the least amount appears in the milk. Having the mother take the medication immediately after breast-feeding is often the safest time for the infant.
- Watch the infant for any unusual signs or symptoms such as change in feeding pattern or sleeping habits, fussiness, or rash.

Caffeine

Caffeine is found in coffee, tea, chocolate, many soft drinks, some foods and many drugs (see Appendix A). Only one percent of the caffeine ingested by a nursing mother will reach her infant, but infants do not eliminate this stimulant efficiently; it accumulates over time. In one study involving 15 infants the mean half life for caffeine was 82 hours (45). The result is a wide-eyed, active, alert infant. Infants may develop these symptoms if a nursing mother drinks more than six to eight cups of any caffeine containing beverage daily. These symptoms usually disappear once the mother switches to caffeine-free beverages (46).

The United States Food and Drug Administration have recommended that adults limit their use of caffeine containing products to a total of 400 milligrams per day. This recommendation is not specific to lactating women. Common sense would suggest that less than 400 milligrams per day would be desirable for this special group.

Alcohol

Traditionally a glass of heavy ale was recommended for a mother before the late afternoon feeding - a time when mothers are under pressure to feed both infant and family. Indeed, it is known that small amounts of alcohol (one to two drinks per day) aid the let-down reflex (47, 48). Although few studies have documented the deleterious effects of alcohol on the suckling infant, moderate to heavy drinking (four to seven drinks per day*) can interfere with oxytocin release and inhibit the let-down reflex (47, 48)

Blood alcohol rises almost immediately after drinking (50) and the alcohol content of breast milk is similar to the mother's blood alcohol level (43). It is recommended that nursing mothers eliminate alcohol consumption. If alcohol is consumed, it should be limited to one drink per day.

Smoking

1. Cigarettes

Cigarette smoking reduces the amount of breast milk produced (51) and may interfere with the let-down reflex (48).

Nicotine is one of the most toxic of all drugs. Since nicotine is fat-soluble, it is transmitted to the infant via the breast milk. Nicotine is absorbed slowly, thus protecting the infant from experiencing a toxic reaction, particularly if the mother is a heavy smoker (52).

Much of the medical research on the harmful effects of second-hand smoke concerns the pediatric population. Passive exposure to parental cigarette smoking is associated with an increased morbidity from respiratory illness in young children (53). Infants whose mothers smoke are more likely to be admitted to hospitals with bronchitis or

* 1 drink can be defined as follows (49):

340 mL (12 oz.) beer,
142 mL (5 oz.) wine, or
43 mL (1.5 oz.) of 80-proof liquor

pneumonia than are infants whose mothers do not smoke (54). Colley showed that in the first year of life exposure to cigarette smoke generated when parents smoked doubled the risk for the infant of an attack of pneumonia or bronchitis (55).

It is recommended that mothers do not smoke while nursing, and infants should not be exposed to cigarette smoke (56,57,58).

2. Marijuana

Marijuana poses an entirely different risk. Although there is no data available on whether marijuana is found in human milk, Δ-9 tetrahydro-cannabinol (THC), the presumed active ingredient in marijuana, is fat soluble and is capable of being stored in the body for a long time (59).

Animal studies have shown that structural changes occur in the brain cells of newborn animals nursed by mothers whose milk contained cannabis. Nahas and co-workers describe impairment of DNA and RNA formation and of proteins essential for proper growth and development (60). Since brain cell development is still taking place, any remote chance that DNA and RNA metabolism is altered should be viewed with concern.

Environmental Pollutants Found in Breast Milk

The current concern over pesticide residues, industrial wastes, and other environmental contaminants is not without cause. More than 1000 new chemicals are introduced into industry each year (61), and some constitute a significant health hazard.

PCB's (Polychlorinated biphenyls)

PCB's have been used commercially for over 40 years. This chemical is used as insulating fluid in electrical transformers and cooling systems. Recently, episodes of accidental contamination of foods with PCB's have focussed attention on the severe damaging effects these compounds can have.

Potential sources of PCB's are waste oil spread on the roads, incomplete destruction of PCB's during disposal by incineration, and leaching of PCB's into water supplies from underground disposal dumps. Fresh water fish living in polluted rivers and lakes can concentrate PCB's.

PCB's are not biodegradable. They are not excreted in the urine; they are concentrated in fat tissue where they remain for a long time. They are transferred across the placenta and breast milk has been shown to contain PCB's. Although the significance of long term, low level body burdens of PCB's is not known, there is a continuing public concern about the possible damaging effect of feeding breast milk containing PCB's to infants.

In a recent provincial study, PCB levels in mothers's milk in B.C. averaged 12 parts per billion - well below the federal guidelines of 50 parts per billion.

Nursing mothers are advised to:

- avoid eating fresh water fish from contaminated lakes and rivers (i.e. the Great Lakes Water System).
- decrease fat consumption by eating lean meats, removing the skin from chicken before cooking, and using low fat dairy products.

DDT (Dichloro diphenyl trichloroethane)

DDT has been banned in many countries. Some reports from the United States and other countries indicate that in spite of the ban, the average daily intake of DDT by infants is still considerably higher than the maximum daily intake proposed by the World Health Organization (43, 62).

In Finland, for example, DDT has been restricted since 1971, yet the average intake by Finnish breast-fed babies was reported to be 1.9 times higher than World Health Organization acceptable levels (43).

The major dietary sources of pesticides are foods of animal origin, such as meat and dairy products. Thus, a moderate to low fat diet may be one way of helping to reduce further accumulation of these chemicals in the body.

Concern about the effects of these environmental pollutants on nursing infants must be tempered by the knowledge that breast milk is uniquely suited to the nutritional needs of the infant and contains many factors which protect against infections and cannot be duplicated in infant formula.

FOR MORE INFORMATION

Resource Books

1. Lawrence, R.A. Breast-feeding: A Guide for the Medical Profession, The C.V. Mosby Company, St. Louis, 1980.
2. Worth, C. Breastfeeding Basics, McGraw-Hill Ryerson, Scarborough, 1983.
3. Goldfarb, J. and E. Tibbetts. Breast-feeding Handbook: A Practical Reference for Physicians, Nurses and Other Health Professionals, Enslow Publishers, Hillside, New Jersey, 1980.
4. Helsing, E and F.S. King. Breast-feeding in Practice: A Manual for Health Workers, Oxford University Press, Toronto, 1982.
5. Riordan, J. A Practical Guide to Breastfeeding, The C.V. Mosby Company, St. Louis, 1983.
6. Ewy, R. and D. Ewy. Preparation for Breast-feeding, Doubleday, New York, 1975.

Community Health Services

The local health unit provides a number of pre- and postnatal services aimed at assisting parents in caring for the new baby. Parents can either phone or visit their local health unit for more information.

The following book is available to all expectant parents in British Columbia:

> Baby's Best Chance: A Perinatal Manual for Parents. Province of British Columbia, Ministry of Health, 1979.

La Leche League

La Leche League runs classes on breast-feeding and offers support and help from other nursing mothers. It has chapters throughout Canada. Local chapters are listed in the phone book. Many printed materials are available including a book entitled The Womanly Art of Breastfeeding, La Leche League International, Franklin Park, Illinois, 1981.

APPENDIX A

APPROXIMATE CAFFEINE CONTENT OF SOME BEVERAGES, FOODS AND MEDICATIONS (63-69)

BEVERAGES	CAFFEINE mg/200 mL (approximately 7 oz.)
Soft Drinks	
Regular Colas	23-42
Diet Colas	21-35
Caffeine-free Colas	.08
Coffee	
Instant	82-94
Percolated	130-166
Dripolated	182-204
Flavoured Coffees	58-122
Decaffeinated Coffee	6-10
Bagged Tea	
Black, 5 minute brew	56-72
Black, 1 minute brew	30-48
Loose Tea	
Black, 5 minute brew	58
Green, 5 minute brew	50
Green, Japan, 5 minute brew	30
Iced Tea	12-26

CHOCOLATE	CAFFEINE mg
Chocolate bar, 30 g (1 oz.)	5-20
Chocolate, baking, 30 g (1 oz.)	45
Cocoa/Hot Chocolate, 200 mL (7 oz.)	8-14
Chocolate Syrup, 30 mL (2 T.)	10-17

MEDICATIONS	CAFFEINE mg/tablet
Non-Prescription	
Aspirin Compounds, Bromo Seltzer	32
Cope, Midol	32
Excedrin, Anacin	32-60
Dristan, Sinarest	30
No Doz	100
Vivarin	200
Pramaline, Dexatrim	140-200
Coricidan	32
Prescription	
APC's	
(Aspirin, Phenacetin & Caffeine)	32
Darvon Compound	32
Migral	50

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CHAPTER II

ALTERNATE FEEDING

GUIDELINES AND SUMMARY

- *Regardless of whether or not a woman elects to breast-feed, all mothers should be strongly encouraged to nurse for at least two weeks.*

- *Parents choosing to bottle-feed should be aware that it is possible to over-feed. Bottle-fed infants should be allowed to vary their intake from one feeding to the next and not be encouraged to finish every bottle.*

- *Commerical formula provides the most desirable alternative to breast milk.*

- *Evaporated whole cow's milk formula is considerably less expensive than commercial infant formula but it is not as nutritious. The saturated butterfat is difficult for some infants to digest before four to six months. The linoleic acid is limited, as are the levels of vitamin D and folate. The solute load from electrolytes and minerals is greater than breast milk or commercial infant formula. Its use is not encouraged.*

- *Goat's milk fat contains more medium and short chain fatty acids, fewer long chain fatty acids and more linoleic acid than cow's milk. These differences suggest that it may be more easily digested than cow's milk. The solute load from electrolytes and minerals, however, is greater than breast milk or commercial infant formula. Goat's milk is extremely low in folic acid, contains no vitamin D and little vitamin C.*

Until an infant is receiving sufficient amounts of these nutrients from other sources, evaporated goat's milk formula must be prepared from evaporated goat's milk enriched with vitamins C, D and folic acid. Not all products are enriched.

- *Whole cow or goat milk (pasteurized fluid, reconstituted powdered or reconstituted evaporated) should not be offered until after six months and preferably not until nine months. An infant should be eating at least 240 millilitres (eight ounces) of a variety of solids daily before whole milk completely replaces either breast milk or infant formula.*
- *Clinical and epidemiological evidence suggest that two percent milk may be safely introduced after twelve months. However, diets including two percent milk are lower in fat and higher in protein than is recommended, and it may be preferable to wait until 18 months.*
- *Skim milk is even lower in fat and higher in protein than two percent milk and is probably best left until two years of age.*

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THE DECISION TO BOTTLE-FEED

For one mother and baby, breast is best; for another, bottle-feeding is preferable. Physiologically, breast milk is optimal, but there are other considerations that are important and should be respected. However, all mothers should be strongly encouraged to nurse for at least the first two weeks. This provides the infant with valuable colostrum, clears away meconium (1), readies the baby's digestive tract, and stimulates the mother's uterine contractions. It enhances maternal-infant bonding and gradual weaning is more comfortable than "drying up" after childbirth.

Parents choosing to bottle-feed should be aware that it is possible to over-feed. Whereas the nursing mother does not really know how much milk her baby consumes, bottle-fed babies are often encouraged to finish each bottle. Just as an adult's appetite varies from day to day, so does a baby's. Parents should respect their baby's decision to finish the bottle one day and leave some the next day.

MILK - VARIATIONS IN NUTRIENTS

Milk is an infant's main food during the first year, and must provide the proper balance and types of protein, fat, carbohydrate, vitamins and minerals. Variations between different milks are summarized in the following paragraphs.

Fat

Milk is the major dietary source of fat during the first year. Breast milk, considered to be optimal for infants, contributes more than half its calories as fat. Commercial infant formulas and those prepared from evaporated or fresh whole cow's milk provide similar amounts. Skim milk is clearly undesirable, and two percent milk represents a poor compromise (2).

The role of fat is multi-faceted. Fat is essential for brain development; it is a component of myelin, the covering sheath of nerve fibres. The most rapid period of myelin synthesis is around birth, but there is evidence that sufficient synthesis continues to two years of age (3). Fat is needed to absorb and transport the fat soluble vitamins: A, E, D and K.

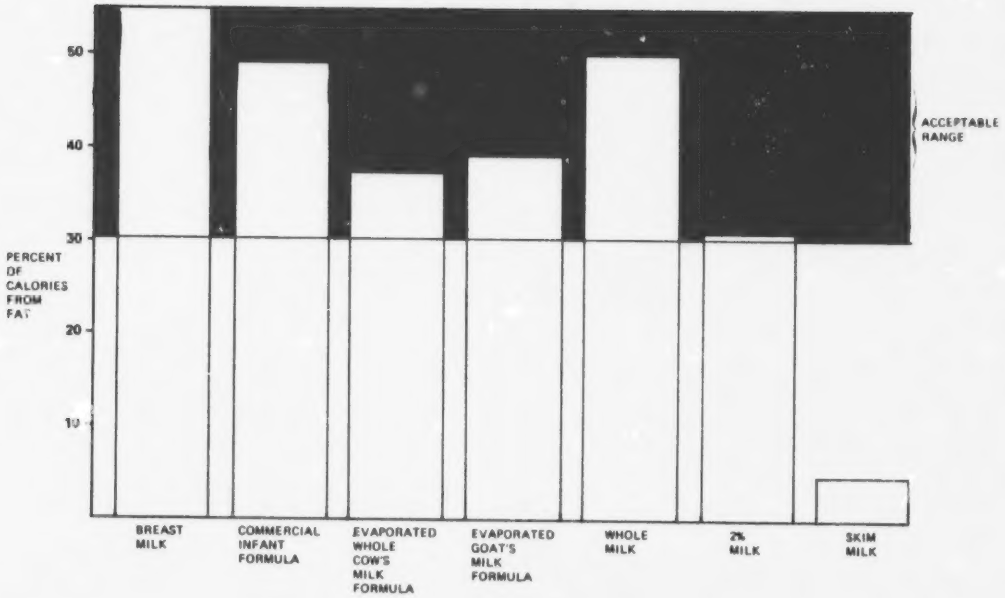

Figure 2.1: Percent Distribution of Calories from Fat in Selected Milks. Shaded area indicates acceptable range (5).

The fat present in cow's milk is primarily saturated butterfat, which young infants may find difficult to digest before four to six months (4). The better absorption of human milk fat than of butterfat appears to be due to the triglyceride arrangement of the fatty acids. Palmitic acid accounts for a substantial percentage of the weight of total fatty acids of each of these fats but, in butterfat, is nearly equally distributed among the three positions of the triglyceride molecule, whereas the palmitic acid in human milk is primarily esterified in the two position (5).

In the production of commercial formulas the butterfat is removed and replaced with more easily digested unsaturated vegetable oils (olive, soybean, cotton-seed, coconut, corn and safflower oil).

The requirement of humans for essential fatty acids has been thoroughly documented. Diets free of linoleic acid induce skin lesions, poor weight gain and slow wound healing in infants (6). It is recommended that no less than one percent of an infant's total energy intake be comprised of linoleic acid and an intake of four percent appears to be optimal (7). Commercial infant formulas contain two to three times this amount (8). Whole cow's milk provides only 0.6 to 0.8 percent of its total calories as linoleic acid (7); two percent milk provides only 0.3 to 0.4 percent; skim milk provides even less.

Protein

Whole cow's milk contains three times as much protein as breast milk, to support the calf's rapid growth and maturation. Low fat milks are even higher in protein. This may stress a young infant's immature kidneys and lead to dehydration, especially if compounded with adverse conditions such as fever, diarrhea, vomiting or very hot weather. Boiled skim milk is sometimes suggested for diarrhea, but should never be fed. Boiling further reduces the water content and the resultant renal solute load is excessive.

The protein level in commercial and home prepared infant formulas has been lowered to approach the protein level in breast milk.

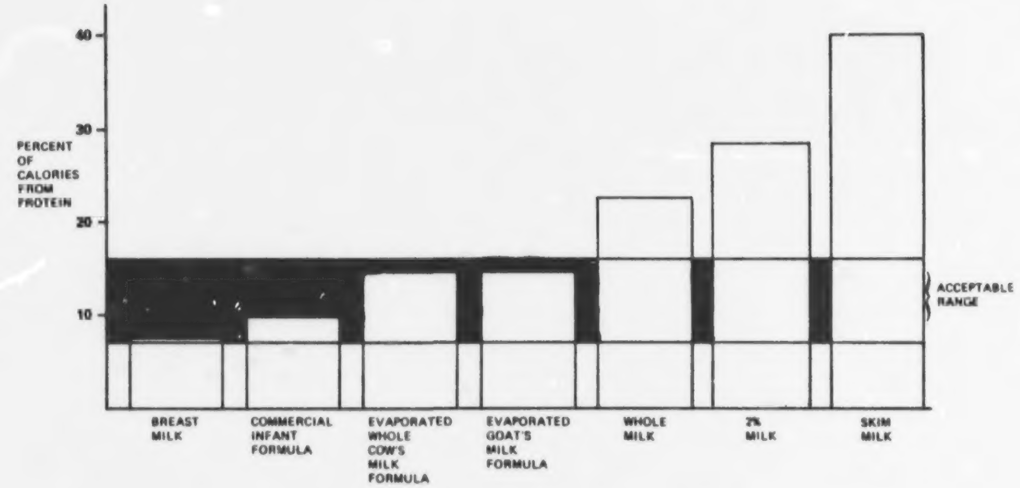

Figure 2.2: Percent Distribution of Calories from Protein in Selected Milks. Shaded area indicates acceptable range (5).

Casein, the predominant protein in cow's milk, forms firm, poorly digested curds in the infant's stomach (9). The large curds can damage the intestinal lining of very young infants and cause a loss of blood. Anemia may result when more than one litre of cow's milk is consumed daily (10). Commercial infant formulas and evaporated milk are heat-treated beyond pasteurization; the digestibility of casein is improved. Several commercial infant formulas have been modified so that the whey:casein ratio approaches that of human milk (i.e. 60:40).

Carbohydrate

Whole cow's milk and reconstituted evaporated whole cow's milk are not suitable for young infants because of the low carbohydrate content. Formula from reconstituted evaporated milk is prepared by diluting with water and adding carbohydrate, to make the nutrient concentration more closely resemble breast milk.

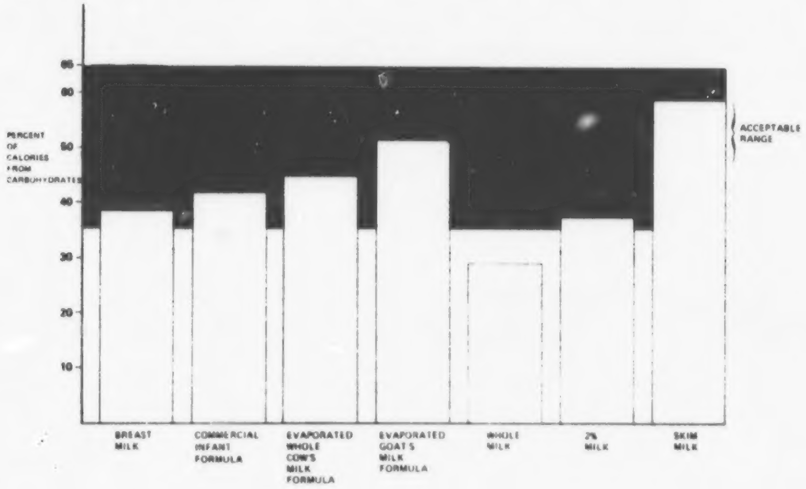

Figure 2.3: Percent Distribution of Calories from Carbohydrates in Selected Milks. Shaded area indicates acceptable range (5).

Minerals and Electrolytes

Cow's milk is much higher in minerals and electrolytes than either breast milk or commercial infant formulas (Table I). As with excess protein, extra minerals and electrolytes place added stress on an infant's immature kidneys.

TABLE I

APPROXIMATE ELECTROLYTE AND MINERAL CONTENT OF TYPICAL MILKS

	Sodium	Potassium (milliequivalents/litre)	Chloride	Calcium (milligrams/ litre)	Phosphorus (milligrams/ litre)
Breast milk	7	13	11	340	140
Commercial infant formula	14	22	18	575	500
Whole cow's milk	21	36	29	1152	908
Two percent milk	21	38	35	1192	928
Skim milk	22	42	*	1212	1004
Evaporated whole cow's milk formula	19	28	*	904	744
Evaporated goat's milk formula	11	35	*	976	808

* Data not available

COMMERCIAL INFANT FORMULA

Commercial infant formula provides the most desirable alternative to breast milk for meeting a baby's nutritional needs (11). Most formulas are made from processed cow's milk, modified to resemble breast milk. The anti-infective properties of breast milk, however, are not duplicated.

Formulas are sold in so many forms - which is best?

Many different formulas are available. Table II lists a variety of formulas which are sold commercially.

TABLE II

SELECTED COMMERCIAL INFANT FORMULAS

(68 calories/100 mL unless specified otherwise)

Name	Company	Chacteristics	Indications for Use
ROUTINE USE			
SMA 20	Wyeth	whey:casein ratio similar to human milk (60:40)	routine infant feeding
Similac with Whey	Ross Laboratories	whey:casein ratio similar to human milk (60:40)	routine infant feeding
Enfalac	Mead Johnson	whey:casein ratio (24:76)	routine infant feeding
Similac 68	Ross Laboratories	whey:casein ratio (24:76)	routine infant feeding
IRON FORTIFIED			
Iron-Fortified SMA	Wyeth	whey:casein ratio similar to human milk (60:40)	when Hb levels = 11.0 g/100 mL and transferrin saturation = 15 percent
		12.7 mg ferrous sulfate/litre	contraindicated with conditions of an abnormal increase in the absorption of iron; i.e. thalassemia

Name	Company	Chacteristics	Indications for Use
Similac with Iron	Ross Laboratories	12 mg ferrous iron/ litre	as above
Enfalac with Iron	Mead Johnson	12.5 mg iron/ litre	as above
DIAGNOSTIC			
R.C.F.	Ross Laboratories	carbohydrate-free soy protein	a base formula which is used to diagnose and treat carbohydrate intolerance; this formula contains no carbohydrate and some must be added
THERAPEUTIC			
Pregestimil	Mead Johnson	hypoallergenic contains casein hydrolysate, glucose, and medium chain triglycerides	for infants with malabsorption disorders or a gastrointestinal disease of some kind
Nutramigen	Mead Johnson	hypoallergenic contains casein hydrolysate and sucrose lactose free	for infants allergic to cow's milk or soy protein or who are lactose intolerant

Name	Company	Chacteristics	Indications for Use
SOY PROTEIN			
Isomil	Ross Laboratories	contains soy protein, corn syrup solids and sucrose lactose free	for use by infants who are allergic to cow's milk protein or who are lactose intolerant
ProSobee	Mead Johnson	contains soy protein, corn syrup solids and sucrose lactose free	for use by infants who are allergic to cow's milk protein or who are lactose intolerant
Nursoy	Wyeth	contains soy protein, corn syrup solids and sucrose lactose free	for use by infants who are allergic to cow's milk protein or who are lactose intolerant
Soyalac	Loma Linda	contains soy protein, corn sugar and sucrose lactose free	for use by infants who are allergic to cow's milk protein or who are lactose intolerant
Iso-Soyalac	Loma Linda	contains soy protein, and sucrose lactose free corn free	for use by infants who are allergic to cow's milk protein, corn or who are lactose intolerant

Name	Company	Chacteristics	Indications for Use
LOW BIRTH WEIGHT/PREMATURE			
Similac Special Care 20	Ross Laboratories		for low birth weight infants less than 2,000 g not sold commercialy
Similac Special Care 24	Ross Laboratories	81 Kcal/100 mL	as above
Enfamil Premature Formula with Whey	Mead Johnson	68 Kcal/100 mL OR 81 Kcal/100 mL	for low birth weight infants not sold commercially
SMA Preemie	Wyeth	81 Kcal/100 mL	for low birth weight infants not sold commerically

Note: Information regarding the appropriateness of any milk feeding not mentioned in this table may be obtained from the local health unit.

Formulas are also available in many different forms and selection will depend upon the convenience desired and the cost (Table III).

TABLE III

APPROXIMATE DAILY COST* OF VARIOUS FORMULAS

Cost per Day	Type of Formula
$1.52	POWDERED concentrate, mixed with cooled boiled water
$1.64	LIQUID concentrate mixed with an equal amount of cooled boiled water
$2.76	LIQUID ready-to-feed
$0.77	EVAPORATED whole cow's milk formula made with corn syrup
$2.93	EVAPORATED goat's milk formula made with corn syrup

* The cost refers to the amount of formula required to make 960 millilitres (32 ounces), the approximate daily requirement of a three month old infant. It is based on prices in Victoria, October, 1983. This does not include the cost of bottles, liners, or sterilizing equipment used in formula preparation.

Soy Protein Formulas

Soy protein formulas contain slightly more protein and slightly less carbohydrate than cow's milk protein formulas. The protein source is usually (but not always) soy protein isolate; the fat is a blend of vegetable oils; and the source of carbohydrate is usually sucrose, corn syrup solids (hydrolyzed corn starch), or a mixture of both. Quantities of other nutrients are similar.

The Amercian Academy of Pediatrics has prepared guidelines for the use of soy protein formulas (12). The Academy recommends soy protein formula for:

- vegetarian infants.
- galactosemia or primary lactase deficiency.
- secondary lactose intolerance resulting from enteric infection or other causes of mucosal damage. Cow's milk protein formula may be resumed after the diarrhea and intestinal damage have been resolved (approximately two weeks after cessation of the diarrhea).
- potentially allergic infants (with a family history of atopy) who have shown no clinical signs of allergy. These infants should be monitored for allergy to soy protein.

The Academy does not recommend soy protein formulas for:

- routine feeding of premature and low birth weight infants. The hypophosphatemia associated with the routine use of soy protein formulas in premature infants may accelerate the development of hypophosphatemic rickets. The reason for the hypophosphatemia is not certain, but it may be due to the binding of some of the soy milk phosphorus with phytate in the formula, making it unavailable for intestinal absorption. Soy protein formulas should only be used for specific therapeutic indications and for periods of no more than three to four weeks.

- cow's milk protein allergy. Allergy to cow's milk protein frequently results in small bowel damage, including villus atrophy. Mucosal permeability to other proteins can result in an increased systemic uptake and immunologic response to these otherwise non-allergenic proteins. A less antigenic formula (i.e. protein hydrolysate) may be warranted in infants already showing clinical signs of allergy.

- colic.

EVAPORATED MILK FORMULAS

Evaporated milk formulas are prepared by further dilution of reconstituted evaporated whole cow or goat milk and addition of a carbohydrate source (sucrose, corn syrup, dextrose, dextrimaltose, or lactose). It provides an acceptable range of calories from fat, carbohydrate and protein.

Evaporated Whole Cow's Milk Formula

Evaporated whole cow's milk formula is considerably less expensive than commercial infant formula but it is not as nutritious. Care must be taken to ensure that the formula is prepared accurately and is not contaminated through poor food handling practices.

The type of fat may be difficult for an infant less than four to six months to digest and absorb (4), the linoleic acid content is limited (7), as are the folate (13) and vitamin D levels (14). As shown in Table I, page 53, the solute burden from electrolytes and minerals is much greater than either breast milk or commercial formula.

A glaring example of the importance of preparing the formula correctly occurred when the parents of a young infant were incorrectly advised to feed an improperly diluted formula from birth. The infant was hospitalized four times during the first six months of life with fever, seizures and severe failure to thrive. He had documented hypocalcemia and hyperphosphatemia. Further investigation revealed that this very serious illness and resultant hospitalization was due solely to a nutritional error, not a metabolic disorder (15).

In view of the limitations of evaporated whole cow's milk formula, its use should not be encouraged. However, there is no clinical or epidemiological evidence documenting harm to infants nourished with evaporated whole cow's milk formula, correctly prepared.

Evaporated Goat's Milk Formula

Goat's milk contains more essential fatty acids such as linoleic and arachidonic acid, and more medium and short chain fatty acids than cow's milk (16). This suggests that the fat from goat's milk may be more easily digested.

Goat's milk is especially rich in niacin, but it does not contain any vitamin D and is very low in vitamin C and folate. These vitamins must be added if the infant is not receiving them from another source. As with evaporated cow's milk formula, the solute load from electrolytes and minerals is greater than breast milk or commercial infant formula.

Some varieties of canned evaporated goat's milk are enriched. Parents should be advised to read labels as not all products are enriched.

COW'S MILK

Whole Milk

The appropriate age at which pasteurized* whole cow's milk may be safely introduced into the infant's diet is unknown and remains an area of controversy (17). The Ministry of Health advises that pasteurized whole cow's milk (fluid, reconstituted powdered or reconstituted evaporated) should not be offered until after six months and preferably not until nine months. An infant should be eating at least 240 millilitres (eight ounces) of a variety of solid foods before whole milk completely replaces either breast milk or infant formula. The following reasons are given.

* If raw milk is used, care must be taken to use milk from healthy animals, collected in sanitary conditions and pasteurized. See pages 77 and 78 for a recipe for home pasteurization.

First, with the trend towards later introduction of solids, a child may not be consuming a variety or quantity of solids until nine months sufficient to balance the high solute load of whole cow's milk. The linoleic acid content of whole cow's milk is limited, as is the level of vitamin C and iron - a variety of foods is important to ensure these nutrient needs are met.

Second, clinical experience indicates that constipation often develops if whole milk is introduced too early. This is due to the low carbohydrate content and high butterfat concentration in whole milk (18).

Third, cow's milk protein is a known allergen. The reported prevalence of cow's milk allergy varies between 0.3 - 7.5 percent (17). Bahna and Heiner (19) have estimated that the true prevalence of cow's milk allergy in the pediatric population of Western countries is between one and three percent. Accordingly, in British Columbia where 40,000 infants are born each year, this represents 1200 infants every year.

In one study (20), the percentage of infants with cow's milk allergy requiring three or more visits to physicians for illness during the first year of life was three times more than that of infants free of allergies; admissions to hospitals were twice those of the non-allergenic infants.

In some studies in which infants showed allergic reactions, cow's milk was frequently introduced when the infant was less than four months old (17). It has been suggested that the prevalence might decrease if cow's milk protein were withheld from the infant diet for the first four to six months. Bahna and Heiner advise that cow's milk be avoided until nine to twelve months in infants with a strong family history of allergy (21). Parents should watch for any unusual symptoms such as diarrhea, excessive spitting up, a rash or coughing.

It must be recognized that gastrointestinal upsets often cause a temporary milk intolerance. Distinction must be made between an intolerance and an allergy. A child with milk intolerance may tolerate milk that has been heat-treated or may tolerate small amounts of milk, or milk products. The intolerance may have resulted from mucosal damage by large insoluble curds, or may have been caused by a sensitivity to lactose. This type of intolerance is usually short-lived. Milk allergy, on the other hand, is due to an antigen-antibody response.

If milk intolerance is mistaken for an allergy to cow's milk, a child may be taken off cow's milk for months or even years - often unnecessarily. Milk products should be introduced from time to time, unless the child exhibits a violent allergy to milk protein.

The issue of occult blood loss and anemia requires further clarification. There is evidence that gastrointestinal blood loss may be associated with ingesting fresh cow's milk (22) that has not been heat-treated, beyond pasteurization temperatures, to denature the protein. Milk protein damages the gastrointestinal mucosa and results in a breakdown of mucosal cells, a loss of blood and iron deficiency anemia. The infants in these studies were very young when initially given whole milk, however. If the developing gut is more vulnerable early in life, it is possible that the damage may be avoided by delaying the age at which it is first introduced.

Low Fat Milk

A practice that has come to the fore in recent years is that of feeding two percent or skim milk to infants. The assumption is that the reduced fat intake will prevent obesity and will lead to "healthier" infants. This is an example of the misconception that what is good for adults must be good for children (23). Although Canadians have been advised to reduce fat in the diet to 35 percent of total energy intake, this recommendation does not apply to children under two years (24,25).

Clinical and epidemiological evidence suggest that two percent milk may be safely introduced after twelve months. However, diets including two percent milk are lower in fat and higher in protein than is recommended, and it may be preferable to wait until 18 months.

Skim milk is even lower in fat and higher in protein than two percent milk and is probably best left until two years of age.

GOAT'S MILK

Pasteurized* goat's milk (i.e. fluid, reconstituted powdered or reconstituted evaporated) should not be offered until after six months and preferably not until nine months. An infant should be eating at least 240 millilitres (eight ounces) of a variety of solids daily (including good sources of folate) before goat's milk completely replaces either breast milk or infant formula. The following reasons are given.

First, the renal solute load of goat's milk is only slightly lower than that of cow's milk. A sufficient quantity of food is needed to balance the renal solute load. Second, goat's milk contains no vitamin D, relatively little vitamin C and is extremely low in folate, so much so that if used exclusively, folate deficiency anemia is probable (26). A sufficient variety is important to ensure these nutrient needs are met.

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* If raw milk is used, care must be taken to use milk from healthy animals, collected in sanitary conditions and pasteurized. See page 77 and 78 for a recipe for home pasteurization.

Folate plays an important role in cell division and a shortage of folate impedes growth. A baby is born with adequate stores of folate. Soon after, the blood folate level begins to decrease, and reaches a low point at six to eight weeks. From that age on, the infant is dependent on the diet for folate. The period between two and six months is critical. Characterized by a high growth rate, the infant during this period has maximal folate requirements. If intake is marginal (as is the case if an infant is fed only goat's milk), a shortage of folate may affect growth. Growth slows down after six months, and there is a relative decrease in folate requirements (26).

Folate is lost through cooking (13), so cooked baby foods are not a good source. Orange juice is an excellent source, however. A 90 millilitre serving of fresh or frozen reconstituted orange juice supplies the total daily requirement (26). Orange juice may be introduced at six months in infants without a strong family history of allergy. Folic acid supplements are available but are usually sold in amounts 100 times more than an infant requires. Folate requirements are best met through food.

Folate Content of Selected Foods (13)

Food	Amount	Total Folate (ug)
Orange juice, fresh or frozen reconstituted	90 mL (3 oz.)	51
Banana	1/2 medium	16
Whole wheat bread	1 slice	8
Egg yolk, strained	28 g	6

Goat's milk has often been recommended for infant feeding when intolerance to cow's milk is suspected. However, it is estimated that only one-third of infants who are sensitive to cow's milk can tolerate goat's milk (27).

Goat's milk is also recommended for the treament of milk allergy. Both milks have approximately 20 different protein fractions. Some proteins are common to both milks while others are not. Goat's milk is only suitable if an infant is allergic to a protein fraction from cow's milk that is not present in goat's milk.

INFORMATION FOR PARENTS ON BOTTLE-FEEDING

Formula Temperature

Formulas may be fed at cool, room or body temperature depending upon a baby's preference. If formula is to be warmed, the bottle of formula is heated in a saucepan with water or in an electric bottle warmer. Temperatures should not vary appreciably from one bottle to another; babies become conditioned to the temperature of the food and may refuse their feeding if it differs.

Formula may be warmed in a microwave oven, according to the manufacturer's instructions. Reusable glass bottles should be used, not plastic ones, for two reasons. First, some plastics contain polyvinyl chloride (PVC), polystyrene or melamine resins. Heating foods contained in these plastics may cause potentially poisonous materials to leak into the food, even at temperatures as low as 60 degrees Celsius (28). Second, disposable plastic bags might split and spill hot milk on the baby.

The time required to warm the infant formula in the microwave is extremely brief (approximately 10 seconds). There is a danger of overheating which will alter the digestibility of the protein. Milk continues to cook once it is removed from the microwave. It may also heat unevenly, resulting in hot spots. For best results, rotate the bottle, swirling the contents and then let milk stand for a few minutes before serving. Bottles should not have the caps or nipples on when being warmed.

Drinking from a Bottle

The size of the nipple holes and the tightness of the nipple collar influence the flow. The looser the seal and the larger the hole, the faster the feeding. If nipple holes are too large, a baby will choke or drink in gulps and swallow too much air. If the holes are too small, the baby will tire of sucking before receiving sufficient formula.

Occasionally a nipple may collapse during feeding causing a partial vacuum and stopping the flow of formula. When this happens, loosen the cap to let air into the bottle, then tighten the cap and resume feeding.

A baby should not suck on an empty bottle. He will swallow a large amount of air, causing gas and stomach discomfort.

How Much Formula Does a Baby Drink?

The amount of formula a baby drinks varies according to weight, rate of growth, and activity. Table IV gives a general guideline, but not every baby will progress exactly as the chart indicates, and there will be fluctuations.

TABLE IV

HOW MUCH FORMULA DOES A BABY DRINK? (28)

Age	Number of feedings within 24 hours	Amount of formula per feeding (mL)
Birth - 1 week	6-10	60-90
1 - 2 weeks	6-8	60-90
3 weeks - 2 months	5-7	120-150
2 - 3 months	5-6	150-180
3 - 4 months	4-5	180-210
5 - 7 months	4-5	210-250
8 - 12 months	3	210-250

When To Offer More Formula

When a baby finishes his bottle at every feeding for at least two consecutive days and appears ready for more formula, an additional 30 millilitres should be added to each feeding. Growth spurts often occur at two weeks, six weeks and three months. During these times a baby needs slightly more formula at a feeding. Once the growth spurt finishes, appetite reduces and less formula is required. Mothers should be cautioned not to force remaining formula. A baby's appetite usually reflects need.

When A Baby Doesn't Drink Much Formula At A Feeding

A baby may not finish his bottle for several reasons. First, the amount of formula in a baby's bottle may be more than he needs for his age, and he is satisfied long before the bottle is empty. Second, he may be drinking a bottle of juice or water too close to feeding time, leaving little room for formula. Finally, he may be eating too much solid food.

INFORMATION FOR PARENTS ON FORMULA PREPARATION

Equipment - Wash Then Sanitize

Bottles, caps, nipples and nipple collars must be thoroughly washed with soap or detergent and rinsed well, before sanitizing. It is important that all old formula or milk is removed. Pay particular attention to cleaning inside the bottles. Water should be squeezed through each nipple to ensure that the holes are not clogged with formula or saliva. Rinse carefully to remove traces of detergent.

Place bottles upside down on a rack in a deep pan. If no rack is available, a clean folded dishcloth in the bottom of the pan will work. Place nipples, nipple collars and caps in a jar* with a lid that has holes in it and put in the pan. Add about eight centimetres (three inches) of water and cover the pan with a lid. Bring the water to a boil and

*This prevents the rubber from burning

continue to boil for five minutes. Immediately fit the nipples upside down onto the bottle, covered with caps and attached with collars, taking care not to touch the nipples. These clean bottles can be filled with formula when needed.

When a baby is three months old, it is no longer necessary to put bottles, nipples, caps and nipple collars through the "five minute boil" process. Simply wash thoroughly, rinse well and air dry.

Bottles may be sanitized in a dishwasher providing the temperature reaches 60 degrees Celsius in the final rinse and maintains that temperature for thirty minutes. Wash all nipples, nipple collars, caps and bottles as described above. Place washed bottles on the top rack of the dishwasher. Nipples, nipple collars and caps should be put in a small wares basket, closed and placed on the bottom rack of the dishwasher. Run the dishwasher through a complete wash and dry cycle. Rinsed dishes can be washed with them at the same time. Open the dishwasher and assemble the bottles, being careful not to touch the nipples.

The Ingredients

Water

Tap water should be boiled at a rolling boil for five minutes in a covered pan or kettle and then cooled before using. This is sufficient to destroy any microorganisms present.

By three months it is no longer necessary to boil tap water unless the water supply is questionable. A water analysis service to determine safety of the water supply is available to residents of British Columbia.

Direct enquiries to:

Environmental Laboratory
Ministry of Environment
3650 Wesbrook Mall
Vancouver, B.C.
V6S 2L2.

Formula should not be mixed with tap water and then heated in a microwave oven; there are no guidelines available on the time required to render the formula safe, while maintaining the nutritional quality of the formula.

Water from a private water supply (a well or dugout) should be tested for the presence of nitrates. Boiling does not destroy nitrates but further concentrates them in the water.

Commercial Formula

To prepare commercial formula, the correct amount of boiled, cooled water is first poured into a clean bottle. Water must be cooled because hot water will destroy some of the vitamin C in the formula. The measured portion of formula powder or concentrated liquid is then added and mixed.

Formula must be accurately mixed, according to directions. If formula for more than one bottle is prepared at a time, the mixing container must be sanitized, as well as all measuring utensils.

Home Prepared Formula

1. Recommended carbohydrate sources

The preparation of formula from evaporated milk (cow's or goat's) includes both further dilution of reconstituted evaporated milk with water and addition of carbohydrate, to make the nutrient concentation more closely resemble breast milk. Suitable carbohydrate sources include lactose, dextrose, dextrimaltose, corn syrup or white table sugar (sucrose).

Corn syrup and sugar can both produce decay during tooth eruption. Daily oral hygiene, such as brushing is essential as soon as teeth erupt. More information on preventive dental health is contained in Your Baby's Smile. This package is available through local health units to all new mothers in British Columbia.

Honey is not recommended as a carbohydrate due to the risk of infant botulism. Although exceptionally rare, exposure to honey accounts for 35 percent of all known hospitalized cases of infant botulism, and should not be fed to children under one year of age (30). A recent U.S. nationwide survey identified corn syrup as a possible additional source of Clostridium Botulinum spores (31) but to date there has not been enough scientific data to warrant recommending that it not be fed to infants.

Regardless of the carbohydrate used, careful attention to cleanliness is essential to prevent contamination from dust and dirt or other modes of transmission of Botulimum spores.

2. Recipes for Evaporated Milk Formulas

Tables V and VI list recipes in metric and imperial measures for evaporated whole cow's milk and evaporated goat's milk. The method for both recipes is the same:

> The correct amount of boiled water is poured into a sanitized bottle or container. An appropriate quantity of carbohydrate is dissolved in the water and then cooled. The measured portion of milk is added once the mixture has cooled.

TABLE V

RECIPE FOR EVAPORATED WHOLE COW'S MILK FORMULA

a. Metric (millilitres)

Quantity of Formula to be Prepared	Evaporated Whole Cow's Milk	Boiled Water	Carbohydrates:						
			Sucrose Or Dextrose	Or	Corn Syrup	Or	Dextri-maltose	Or	Lactose
1155	385 (1 tin)	770	70		55		120		80
960	330	630	50		40		90		55
720	240	480	40		30		70		45
240	80	160	15		12		25		15

RECIPE FOR EVAPORATED WHOLE COW'S MILK FORMULA (cont'd)

b. Imperial

--------ounces-- ---- ---			----------tablespoons- -------						
					Carbohydrates:				
Quantity of Formula to be Prepared	Evaporated Whole Cow's Milk	Boiled Water	Sucrose Or Dextrose	Or	Corn Syrup	Or	Dextri-maltose	Or	Lactose
39	12 4/5 (1 tin)	26 1/5	4 2/3		3 2/3		8		5 1/3
32	11	21	3 1/3		2 2/3		6		3 2/3
24	8	16	2 2/3		2		4 2/3		3
8	2 2/3	5 1/3	1		3/4		1 2/3		1

TABLE VI

RECIPE FOR GOAT'S MILK FORMULA

a. **Metric (millilitres)**

Quantity of Formula to be Prepared	Evaporated Goat's Milk enriched with folate, vitamin C and vitamin D	Boiled Water	Carbohydrates: Sucrose Or Dextrose	Or	Corn Syrup	Or	Dextri-maltose	Or	Lactose
1019	369 (1 tin)	650	65		50		110		75
720	270	450	40		35		75		50
240	90	150	15		10		25		15

RECIPE FOR GOAT'S MILK FORMULA (cont'd)

b. Imperial

-------ounces----------			-------------tablespoons-----------			
			Carbohydrates:			
Quantity of Formula to be Prepared	Evaporated Goat's Milk enriched with folate, vitamin C and vitamin D	Boiled Water	Sucrose Or Dextrose	Or Corn Syrup	Or Dextri-maltose	Or Lactose
34	12 1/3 (1 tin)	21 2/3	4 1/3	3 1/3	7 1/3	5
24	9	15	2 2/3	2 1/3	5	3 1/3
8	3	5	1	2/3	1 2/3	1

3. Soy Milk Formula

An information letter on home prepared soy milk formula is available from the local healh unit.

4. Storing Formula

Once opened, all liquid formulas must be covered, refrigerated and used within 24 hours. Any formula remaining after this time should be discarded or used in cooking. An opened can of powdered formula should be stored covered but needs no refrigeration.

Leftover formula should not be saved. Any formula from a feeding that is not used within two hours should be discarded.

5. Home Pasteurization of Milk

Milk that is not pasteurized (i.e. raw milk), even from certified farms, can be a source of salmonella and campylobacter which may cause severe intestinal distress (32). Raw milk requires safe handling from the animal to the home. This includes the cleansing of the teats, the milker's hands, the use of sanitized containers, pasteurization and immediate refrigeration.

Equipment:
- Cooking thermometer
- Double boiler, or equivalent
- Spoon
- Storage containers with tight lids

The thermometer must be accurate. Check, first by putting it in boiling water; the temperature should register 100 degrees Celsius or 212 degrees Fahrenheit. Second, check by putting it in water with lots of ice: the temperature should register close to 0 degrees Celsius or 32 degrees Fahrenheit. Do not attempt home pasteurization without an accurate thermometer.

Method:
Prepare the equipment first. Wash top of double boiler, spoon, thermometer, storage containers and lids with hot, soapy water. Rinse with boiling water and place upside down on a rack to dry.

Bring water to boil in the bottom of the double boiler.

Put milk in double boiler top; put in place over the double boiler bottom. Heat milk to 63 degrees Celsius (145 degrees Fahrenheit) stirring frequently with the clean spoon to prevent foaming. To check the milk temperature accurately, do not rest the thermometer on the bottom or the sides of the pan, and insert into the milk only two-thirds of the way down. Maintain the milk temperature at 63 degrees Celsius for 30 minutes. Higher temperatures cause a change in flavour; lower temperatures will not destroy the microorganisms.

Remove the milk from heat, pour into storage containers, cover, and REFRIGERATE IMMEDIATELY.

Vitamin D is added to milk sold commercially in order to prevent rickets. Infants fed home pasteurized milk should be given a vitamin D supplement of 400 International Units.

APPENDIX A

APPROXIMATE NUTRIENT COMPOSITION OF SELECTED MILKS[a]

100 mL

Nutrient Name	Unit	Human Milk	SMA	Enfalac	Similac 20	Evaporated Whole Cow's Milk Formula	Evaporated Goat's Milk Formula	Whole Cow's Milk	Two Percent Milk	Skim Milk	Goat Milk
Calories	KCAL	69.563	67.600	68.000	68.000	65.278[b]	67.835[b]	61.441	49.672	34.912	68.813
Protein	GM	1.030	1.500	1.500	1.500	2.270	2.670	3.290	3.330	3.410	3.560
Total Fat	GM	4.380	3.600	3.800	3.610	2.520	3.105	3.340	1.920	.180	4.140
Unsaturated Fat	GM	2.000	2.000	1.490	1.000	1.000	0.750	1.200	1.000	.000	1.000
Linoleic Acid	GM	.374	0.450	1.500	1.210	0.056	0.082	.075	.043	.005	.109
Other PUFA	GM	.078	*	*	.190	0.026	0.017	.049	.028	.002	.040
Saturated Fat	GM	2.009	*	*	1.600	1.530	2.000	2.079	1.195	.117	2.667
Cholesterol	MG	13.900	*	*	.000	9.800	8.550	13.600	7.500	1.800	11.400
Total Carbohydrate	GM	6.890	7.200	7.000	7.200	6.472	6.462	4.660	4.800	4.850	4.450
Sugars	GM	9.500	7.200	.700	7.200	0.187	3.637	*	*	*	4.600
Vitamin A	IU	241.000	264.000	170.000	250.000	81.000	138.750	126.000	205.000	204.000	185.000
Vitamin D	IU	5.100	42.300	43.000	40.000	26.333	1.500	42.300	41.000	43.000	2.000
Vitamin E	MG	.200	.950	1.200	1.500	0.247	0.075	.100	.100	*	.100
Vitamin K	MCG	1.500	.006	9.500	[illegible]	2.000	2.250	3.000	3.000	3.000	3.000
Vitamin C	MG	5.000	5.800	5.500	5.500	5.500	0.967	.940	.950	.980	1.290
Thiamin	MG	.014	.070	.050	.060	0.016	0.036	.038	.039	.036	.048
Riboflavin	MG	.036	.105	.060	.010	0.105	0.103	.162	.165	.140	.138
Niacin	MG	.177	1.000	.850	.700	0.065	.208	.084	.086	.088	.277
Vitamin B_6	MG	.011	.040	.063	.040	0.017	0.035	.042	.043	.040	.046
Vitamin B_{12}	MCG	.045	.105	.210	150	0.054	0.049	.357	.364	.378	.065
Pantothenic Acid	MG	.223	.210	.320	.300	0.213	0.232	.314	.320	.329	.310
Folacin	MCG	5.200	5.300	10.000	5.000	2.633	0.450	5.000	5.100	5.200	.600
Biotin	MCG	1.000	.000	1.350	2.000	2.667	1.500	4.000	3.000	2.000	2.000
Calcium	MG	32.200	44.300	57.000	52.000	88.850	102.042	119.400	121.600	123.400	133.500
Phosphorus	MG	13.700	33.000	45.000	39.000	68.167	83.692	93.400	95.100	100.900	110.700
Iodine	MCG	6.000	.007	6.800	.010	5.500	7.667	7.000	8.000	7.000	10.000
Iron	MG	.030	1.270	.200	.210	0.234	0.208	.050	.050	.040	.050
Magnesium	MG	3.400	5.300	4.800	4.000	8.147	10.561	13.440	13.670	11.360	13.970
Zinc	MG	.170	.370	.430	.100	0.312	0.279	.380	.390	.400	.300
Sodium	MG	16.900	15.000	24.500	22.000	38.100	40.183	49.000	49.900	51.500	49.800
Potassium	MG	51.200	56.000	66.000	65.000	101.200	153.350	151.500	154.400	165.600	204.400
Copper	MCG	50.000	50.000	43.000	40.000	0.017	30.001	150.000	20.000	.020	40.000
Manganese	MCG	*	*	110.000	*	1.335	6.000	2.000	2.000	2.000	8.000
Fluoride	MCG	25.000	**	**	**	4.000	15.000	20.000	20.000	20.000	20.000
Chromium	MCG	1.000	*	1.000	1.000	0.708	0.762	1.000	1.000	1.000	1.000
Selenium	MCG	1.200	*	1.200	1.200	1.222	0.914	1.500	1.500	1.500	1.200
Molybdenum	MCG	3.000	*	3.000	3.000	5.083	2.775	5.000	5.000	5.000	3.000

a Data from NUTS Nutrition Assessment System, Version 2, 1983, unless otherwise indicated

b Data from Pennington, J.A.T. and H.N. Church. Bowes and Church's Food Values of Portions Commonly Used. 13th ed., J.B. Lippincott Company, Toronto, 1980; Adams, C.F. Nutritive Value of American Foods in Common Units - Agriculture Handbook No. 456. U.S. Government Printing Office, Washington, D.C., 1975.

* Data not available

** Fluoride content dependent upon municipal water supply where product is manufactured and whether or not the purchased product requires further dilution. Current information on the fluoride content of formulas can be obtained from the Dental Health Division, B.C. Ministry of Health.

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CHAPTER III

INTRODUCING FOODS: WHY, WHEN, HOW AND WHAT?

GUIDELINES AND SUMMARY

- *Solids may be introduced gradually beginning at approximately four to six months, when an infant's birth weight has doubled.*

- *Home prepared baby food must be prepared under sanitary conditions using high quality nutritious food without added salt or sweeteners. To minimize unnecessary loss of nutrients, food should be cooked rapidly, pureed quickly using the cooking liquid when possible, and refrigerated immediately. It should also be warmed then served as quickly as possible.*

- *With regard to commercially prepared baby foods, single flavour fruits without sugar and vegetables and meats without salt are recommended. Meat/vegetable combinations and desserts are not recommended; many of these mixtures are more expensive and not as nutritious.*

-###-

WHY?

A wise selection of solids adds needed calories and provides essential nutrients, such as iron, at a time when infant stores are being depleted. Introduction of a variety of solid foods allows a child to experience the many tastes and textures of foods.

WHEN?

The time of introduction is more important than the order. Introduction of solids before four to six months is discouraged for the following reasons (1).

- Milk is the nutritionally superior food for the very young infant.
- Over-feeding is easily encouraged with young infants.
- The neuromuscular coordination necessary for swallowing solids is not fully developed until after four months.
- The extrusion reflex does not disappear until three to four months.
- High protein foods impose a high renal solute load upon immature kidneys, and can lead to dehydration.
- The addition of solids alters the intestinal flora in a breast-fed infant, and may diminish the immune protection conferred by breast milk.

By four to six months, most infants have doubled their birth weight and require more than a litre of milk to meet their daily energy needs. While milk is an excellent food, too much milk may crowd out foods that provide other needed nutrients such as iron. The gradual addition of solids at this time is recommended. If solid foods are withheld beyond six to seven months, a child may have more difficulty accepting the variety of tastes and textures (2).

Traditionally grain products, such as prepared infant cereals, are introduced first because they are enriched with iron. Vegetables and fruits expose the infant to a variety of tastes and textures; they often are introduced next. Meats and alternates are offered last; their high protein and mineral content is neither needed nor well tolerated by a baby before six months.

Introduction of new foods should occur, one at a time; spaced at least three days apart. In this way, if a baby has an allergic reaction, (wheezing, persistant coughing, diarrhea, rash, or distress), the culprit food is easy to identify. For infants with a strong family history of allergy, spacing of common allergens, (milk, wheat, eggs and corn (3)), should be at least a week. Food mixtures should not be given; the variety of foods contained in them makes it difficult to single out possible allergens.

HOW?

Breast milk or formula should be fed first and then solids between four and six months. At this time, solids are meant to supplement breast milk or formula, not to replace it. After six months, solids are more important as a nutrient source and should be offered first.

Texture

Sucking is a natural instinct. Eating is a learned response. The first solid foods a baby eats should be as thick or slightly thicker than formula to encourage the gradual transformation from sucking to swallowing. At first, almost all of the food given by spoon will dribble out until the infant has learned to use the tongue in the swallowing reflex.

Babies are fast learners. Usually after a week of practice they are ready for food to be of a consistency similar to smooth applesauce.

At approximately six to eight months, texture is added. Food may simply be mashed with a fork. It is important to recommend more texture at this critical stage when a baby is ready to chew. If it is not introduced early enough, some infants may become lazy and will only accept purees for several months to come. Meat is more difficult to chew and should be pureed until eight or nine months. Between nine and twelve months finely cut up table foods can gradually be introduced, alternating them with mashed foods. Junior foods sold commercially do not seem to provide the "chewing challenge" needed in the latter part of the first year and can be bypassed.

WHAT?

General Guidelines for the Selection of Foods:

Infants thrive on nutritious food prepared without:

- added sugar. It contributes unnecessary calories and may condition an infant to prefer sweet foods, predisposing the infant to dental caries and/or obesity.

  Ingredients are listed on product labels in order of decreasing content. Any word ending with "OSE" such as sucrose, dextrose, or lactose, as well as these words - 'invert sugar', 'cane sugar', 'syrup', 'honey', 'corn syrup solids' - indicates that sugar of some type is an ingredient.

- added salt. Salt intake may be a factor in the development of hypertension (4).

- added starches and fillers (frequently added to combination dinners and desserts). These add empty calories and may decrease an infant's appetite for milk.

- nitrates. Nitrates occur naturally in certain vegetables (carrots, beets, spinach and turnip), and some privately owned water supplies (wells, dugouts). Nitrates can be converted to nitrites. Nitrite combines with hemoglobin to form methemoglobin resulting in methemoglobinemia. This potentially fatal condition reduces the blood's ability to carry oxygen and may result in cyanosis and asphyxia (5).

  Water from other than municipally supervised supplies should be tested for nitrates (see page 70 for more information). Boiling does not remove the nitrates but concentrates the level in the water. Case reports of methemoglobinemia related to water intake document the susceptibility of infants aged less than six months (5).

To minimize nitrate risk with home prepared infant foods, fresh or frozen vegetables are suggested rather than long term refrigerated or root cellar storage products (5). There has been no problem with commercial infant vegetables. Meats which have been preserved with nitrites should not be used.

- honey. Honey should not be fed to infants under one year due to the associated risk of infant botulism. Although botulism is exceptionally rare, exposure to honey accounts for 35 percent of all known hospitalized cases (6). Parents should be advised to read labels and buy products that have not been sweetened with honey. Pacifiers should not be dipped in honey as some manufacturers have suggested.

Menu Planning Suggestions for Parents

Cereal: Four to Six Months

Iron-fortified commercial infant cereals are preferred. Homemade strained cereals do not contain as much iron. Infant cereals are available as single grains (rice, oatmeal, barley) or as combinations. Single grain cereals rather than mixed cereals should be used first to assess tolerability of the grain. Well tolerated cereals can be combined later for variety. Wheat and small amounts of wheat germ may be given at six months. Soy cereals currently available are not single grain and should not be offered until after six months. Parents not wishing to purchase commercial infant cereals should introduce meat or dilute prune juice by six months. This will provide the infant with needed iron.

Cereal should not be added to formula and fed to the baby from a bottle. This practice does not encourage learning of the swallowing reflex.

Vegetables and Fruit: Five months

Unsalted vegetables and unsweetened fruits may be introduced beginning at five months. Some mothers find that a baby is more willing to accept vegetables if naturally sweet fruits have not been offered first.

Mild tasting vegetables such as pureed squash, peas, green or yellow beans, asparagus and carrots are more acceptable at first. Stronger flavoured and more fibrous vegetables are added later.

Suitable fruits include cooked pureed apricots, nectarines, peaches, pears, pineapple, plums, prunes and mashed ripe banana. Unsweetened fruit juices may be introduced at the same time as pureed fruits, but should be offered in a cup and should not replace milk. Orange juice may be given at six months when there is no family history of allergy. Otherwise its introduction should be delayed until eight months. Fruit drinks and fruit flavoured crystals are inappropriate and should not be served.

Meat, Fish, Poultry and Legumes: Six Months

Milk remains the most important source of protein during the first two years of life. It provides 20 grams in 20 ounces. A small portion of meat, fish or poultry daily is sufficient to provide additional nutrients and variety. Pureed lamb, chicken or turkey are usually introduced first, followed by beef, veal, liver and pork. Cod, haddock, sole and boston blue fish contain very little fat, are delicately flavoured and provide high quality protein. The vegetarian baby can substitute cottage cheese, tofu or cooked, pureed legumes for meat.

CAUTION: Canned or preserved meat (bologna, weiners, sausages), home pureed ham, fish or poultry with added oil, salt or seasoning should not be given to a baby.

Cottage Cheese, Yoghurt, Grated Cheese and Tofu: Six Months

These foods can be offered at six months. They are easily digested by then and usually well accepted.

Yoghurt is available in many types and flavours - some of these are very sweet or contain berries and are not recommended. Seeds in berries may be difficult to swallow and berries are a common food allergen. Serve plain yoghurt or mix it with a well accepted fruit puree. Yoghurt in baby food jars is not as sweet as regular fruit yoghurt, but, because it is sterilized, it does not offer all the benefits of the lactic culture.

Natural cheeses are preferable to the processed and flavoured spread or squeeze type products. The latter products contain added filler, artificial colouring and unnecessary additives.

Egg Yolk: Six to Eight months

Egg yolk may be soft cooked or hard cooked and sifted in small quantities into pureed vegetables or meat.

Egg White: Eleven months

Egg white is almost exclusively protein and is a highly allergenic food. Even though an infant may be taking a whole egg yolk, begin with one to two millilitres of egg white and increase gradually as long as there is no allergic reaction. A whole egg can be started as soon as egg white is well established.

Fluids

Breast-fed infants do not usually require a water supplement as breast milk meets their normal fluid requirements. Water may be offered occasionally to accustom the infant to a bottle or to a spoon. Infants fed commercial formula do not usually require extra fluids, except during hot weather. Infants fed cow or goat's milk (fluid, powdered, reconstituted evaporated or prepared as a formula) who are eating high solute solids may require extra water to meet their fluid needs.

Parents should be advised not to put a baby to bed with a bottle of milk, juice or any sweet liquid. When an infant sucks, liquids are spread over the teeth. When children are awake they swallow quickly but when they fall asleep sucking stops, and liquids pool around the teeth causing decay. Even milk, though not sweetened, can cause decay when pooled this way. Your Baby's Smile contains more information on preventive dental health. This package is available through local health unit to all new mothers in British Columbia.

Finger Foods

Finger foods can be introduced when chewing movements begin or when babies are able to reach and grasp objects. The teeth may or may not be erupting at this time. Babies enjoy fingering small colourful items - slices of fruit or small pieces of crumbled cheese offer something to pick-up, explore, and eat. Other suggestions include dry toast or cooked vegetables. Small, hard pieces of food which may cause choking should be avoided (nuts, raw peas, raw carrots, kernel corn or popcorn, berries and small candies).

Putting It All Together

At present, precise information is lacking about how much food babies need or eat at various stages of growth. The following guidelines should be considered only as a rough estimate. Actual energy needs for a given infant may be estimated by multiplying the weight in kilograms by the recommended energy requirement, as outlined on page 107. Energy values of some infant foods are provided in Appendix A.

TABLE I

GUIDELINES FOR INTRODUCTION OF SOLIDS

When	What	How Much
4 - 6 months	Dry infant cereal mixed with water, breast milk, formula or diluted fruit juice.	For the first feedings, 5 mL of cereal mixed with 20 mL of liquid. For subsequent feedings, the proportion of cereal to liquid is gradually increased to make the mixture thicker. 5 mL of cereal offered the first day, increasing to 20 - 30 mL by the end of the first week. Then to a maximum of 120 mL daily by the end of the first year.
5 - 7 months	Vegetables and fruit	5 mL strained vegetable or fruit, gradually increased to 45 - 60 mL of each toward the end of the first year.
6 months	Meat, fish, poultry, legumes, cottage cheese, grated cheese or tofu	Amount increased from a taste up to a maximum of 90 mL daily toward the end of the first year.

WHEN	WHAT	HOW MUCH
6 - 8 months	Egg yolk	The tip of a small spoon dipped in a soft cooked egg yolk for the first week, gradually increased to a maximum of 3 egg yolks per week at around 12 months of age.
7 - 8 months	Finger foods	Small pieces of bread crusts, dry toast or unsalted soda crackers; small pieces of cooked vegetables, cooked fruit or soft ripe fruit; or cheese cubes.
11 months	Egg white	1 - 2 mL gradually increased to a whole egg once egg white is well established. At this point, egg yolk alone may be eliminated from the infant's menu.

Commercial Baby Foods

Single flavour fruits without sugar and vegetables and meats without salt are recommended. In 1977, two major Canadian baby food manufacturers eliminated the use of salt in all baby food and reduced the amount of sugar in all fruit and desserts. Meat/vegetable combinations and desserts are not recommended. Many are more expensive and are not as nutritious. Some fruit desserts can contain up to 15 mL of added sugar per 128 mL (7).

Some milk-based or cream-type desserts provide three to six times less calcium than 120 mL of milk and contain added sugar (7). Some meat/vegetable dinners contain only half as much protein as strained or chopped meat; some vegetable/meat dinners contain only one-sixth as much protein.

Home Prepared Baby Foods

Many parents today are choosing to prepare some, most, or all of their own baby foods. Homemade baby food offers many advantages. It is cheaper to make baby food at home. Items can be prepared in quantity. It allows parents control over the basic ingredients. Salt, sugar, starch and fillers are omitted. More variety is possible (fresh fruit and vegetables in season, fresh fish or cooked legumes). Foods from family meals may be used, thus helping in the progression towards mashed and finely chopped family foods when the baby is older.

Home prepared baby food is encouraged. It must be prepared under sanitary conditions using high quality nutritious food without added salt or sweeteners. To minimize unnecessary loss of nutrients, food should be cooked rapidly, pureed quickly using the cooking liquid when possible, and refrigerated immediately. It should also be warmed and served as quickly as possible.

Practical Suggestions for Preparing Baby Food at Home

- Equipment

A fine-meshed sieve and a wooden spoon or a manual food mill are good for fruit and vegetables, but not meats.
Blenders process cooked and canned fruit into a smooth puree but meats tend to shred in the blender rather than puree. It is also difficult to blend less than a 240 millilitre portion because a smaller amount of food does not reach the blade height and therefore is not blended at all.

Electric food processors process any food into a smooth puree - but they are expensive.
Manual food grinders are very useful, particularly for meat. These grinders do fruits and vegetables as well, and are reasonably priced.
Baby food grinders are small versions of standard food mills. They are intended to puree small amounts of vegetables, fruits and soft meats, and are convenient to use when travelling. However, they are not advised if large quantities of food are to be pureed, or for meats such as beef, veal and lamb.

- Selection

Fresh vegetables with no mold, rust or discolouration or plain frozen vegetables without added sauce.

Fully ripe fresh fruit, canned fruits packed in water or their own juice or cooked dried fruit.

Lean cuts of lamb, beef, pork, chicken, turkey, liver, heart or fresh fish.

- Cooking

Wash hands before handling food. Utensils and containers must be impeccably clean.

Wash vegetables and fruit thoroughly. Peel if necessary and slice into small pieces.

Steam fresh vegetables, or add a small amount of boiling water, and cook until tender crisp.

Simmer fruit in a small amount of water until tender.

Broil, roast or stew meats. Do not fry.

Do not add sugar or salt before, during or after preparation.

- Blending or Pureeing

Combine 240 mL drained, cooked vegetables or fruit with 60 mL liquid. Cooking liquid should be used whenever possible. Puree.

Combine 240 mL cooked cubed meat with 120 mL unsalted broth or cooking liquid. Puree.

- Storing

Blended foods should be covered and refrigerated immediately. They may be stored in the refrigerator for two days in tightly covered jars.

Larger quantities may be prepared and frozen in ice cube trays. Once frozen, the cubes can be stored in plastic bags. These will keep in the freezer compartment of a refrigerator for one or two weeks or in a -18 degree Celsius freezer for several months.

- Thawing and Warming

Frozen baby food should never be thawed and refrozen.

Individual food cubes can be defrosted in the freezer or thawed and heated in a baby warming dish. Food cubes can also be placed in a custard cup in a pan of hot water and heated quickly; an egg poaching pot with individual egg cups functions well as a double boiler for heating; food may also be placed directly in a saucepan and heated over very low heat.

Food may be heated in a microwave in a dish or an opened baby jar. Start the oven on the warm setting, or at the lowest level of heat, and test frequently. Baby foods that contain substantial amounts of meat, (plain meats, poultry, egg yolks) should be warmed by conventional methods. Microwave heating of these foods results in uneven heating which might cause the jar to explode. Droplets of water in the food heat faster by microwave than the dense protein and fat particles, and the water turns to steam in small pockets. Stirring the food or shaking the jar or dish when removing from the microwave may result in a hot splatter or scald (8).

APPENDIX A

APPROXIMATE CALORIC CONTENT OF SOME COMMON INFANT FOODS

Food	Portion Size	Calories
Milk		
Human milk	30 mL	21
Commercial infant formulas	30 mL	20
Goat's milk formula, evaporated	30 mL	20
Whole cow's milk formula, evaporated	30 mL	20
Whole cow's milk, reconstituted evaporated	30 mL	21
Goat's milk	30 mL	21
Cow's milk, whole	30 mL	20
two percent	30 mL	18
skim	30 mL	11
Cheese, Yoghurt		
Cottage cheese (creamed)	15 mL	15
Yoghurt, plain (from whole milk)	15 mL	10
Cereals		
Cereals, infant, dry	15 mL	9
Oatmeal, cooked	15 mL	9
Bread	1 slice	56
Arrowroot biscuits	1 biscuit	24
Fruit		
Juice, unsweetened	30 mL	15
Strained or junior unsweetened (commercial)	30 mL	11
Vegetables		
Strained or junior (commercial)	15 mL	5

Food	Portion Size	Calories
Meats		
Strained or junior meats (commercial)	15 mL	15
Eggs		
Egg white	1	16
Egg yolk	1	59
Egg, whole	1	78
Dinners		
Strained or Junior		
+ "Meat with Vegetables"	15 mL	14
++ "Vegetables with Meat"	15 mL	8
Desserts		
Strained or Junior	15 mL	13
Sources of Carbohydrate		
Sucrose	15 mL	46
Corn syrup	15 mL	59
Lactose	15 mL	40
Dextrose	15 mL	45
Dextrimaltose	15 mL	27

+ Protein content is only about 1/2 that of strained or chopped meat.

++ Protein content is only about 1/6 that of strained or chopped meat.

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5. A Guide to Infant Nutrition, The Rationale for Health Professionals, Alberta Social Services and Community Health, Edmonton, 1983, p. 71.

6. Arnon, S.S. et al. "Honey and other environmental risk factors for infant botulism", Journal of Pediatrics, Vol. 94, No. 11, 1982.

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CHAPTER IV

VITAMINS AND MINERALS

GUIDELINES AND SUMMARY

- *By four to six months most infants will have doubled their birth weight, and iron stores may be insufficient to meet the needs of erythropoiesis. Iron-rich foods should be introduced at this time (i.e. prepared infant cereal). Additional supplements are not required.*

- *Vitamin D (400 International Units daily) is recommended for breast-fed infants.*

- *The College of Dental Surgeons of British Columbia recommends fluoride supplementation (0.25 milligrams daily) for infants in communities where there is little or no fluoride in the drinking water (0.0 to 0.3 parts per million). In communities where the drinking water is fluoridated (0.3 parts per million or more), infants should not be given supplements. This applies whether infants are breast-fed or formula-fed.*

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BACKGROUND

Canadian nutritionists, using the scientific information available, together with their best judgement, have developed a set of Recommended Nutrient Intakes (R.N.I.) for infants (Appendix A). The R.N.I.'s outline the estimated calorie and nutrient requirements for infants and provide a basis for current Ministry of Health guidelines.

Supplements are not routinely recommended. Milk, either breast or formula, is a complete food for the first four to six months, not only because of the quality of the food but also because of the nutrient stores with which the infant is born. As long as nutrient dense foods are added to the infant's diet gradually throughout the second six months, the nutrient and calorie needs can be met without supplements. Nevertheless, controversy surrounding iron, vitamin D and fluoride supplementation continues. Rationale to support Ministry of Health recommendations are presented.

SUPPLEMENTATION

Iron

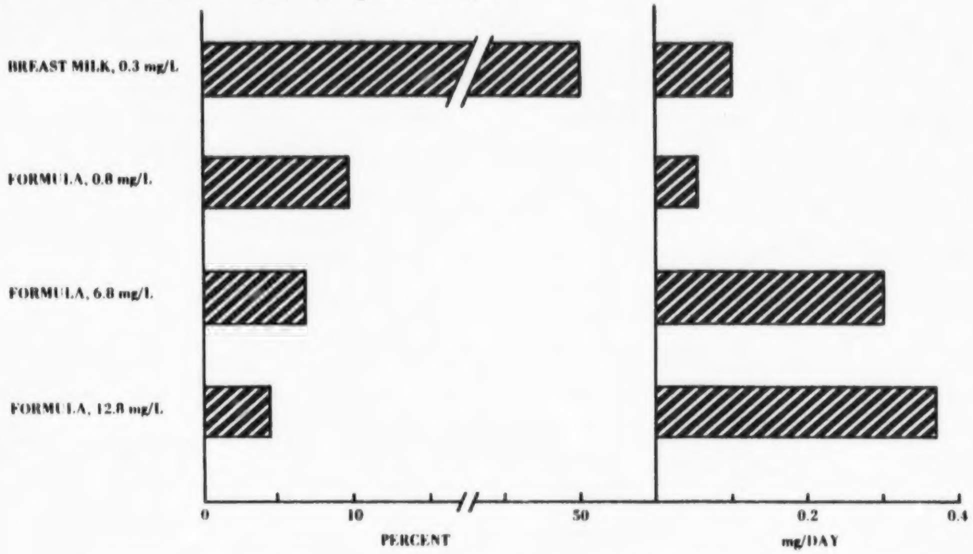
Full term infants are well supplied with iron at birth (1); these stores will be adequate until an infant doubles his birth weight (2). Most infants double their birth weight between four and six months. After this time infants become increasingly dependent upon dietary iron, and introduction of solid food is appropriate. If iron-fortified dry infant cereal is used as one of the first transitional foods, this will take advantage of the improved iron absorption characteristic of the period after four to six months when iron stores become diminished (1).

Fomon (3) recommends that all infants receive supplemental iron from birth. In the normal infant however, little of the orally taken iron is incorporated into hemoglobin during the first four months (1,4), probably due to the inhibitory effect of large iron stores on absorption (2).

Very thin babies who do not double their birth weight until after six months may require iron earlier. The premature infant is not well supplied with iron at birth because most of the iron is transferred from the mother to the fetus in the final weeks of pregnancy (4). Premature infants should be given two milligrams of iron per kilogram, beginning at two months of age, until dietary intake is adequate (4,5).

The Breast-fed Infant

Studies on iron absoprtion have shown that the form of iron in the diet is as important as the amount. Iron in breast milk is highly available and well able to satisfy the exclusively breast-fed infant's needs for the first six months of life (2,6,7). An average of 49 percent of the iron in breast milk is absorbed, compared to 10 to 12 percent for commercial infant formula (6). The mean absorption from iron fortified formulas is about four percent (8) (Figure 4.1).



The percent of iron absorbed is shown on the left. The total amount of iron assimilation that would be predicted from a usual daily intake of 750 millilitres breast milk or formula is shown on the right. Calculations are based on absorption data in Reference 6. The iron content of breast milk or formula is indicated at the far left in milligrams per liter (1).

Figure 4.1: Iron Absorption From Breast Milk and Infant Formula.

Teleologically, the low iron concentration in breast milk may be extremely useful, because there are two bacteriostatic proteins - lactoferrin and transferrin - which lose their bacteria inhibiting properties if saturated with iron (9). Bacterial growth is dependent upon a source of iron. Both lactoferrin and transferrin are believed to inhibit the growth of bacteria by their ability to bind iron so tightly that little is left to support the growth of microorganisms. The iron, however, is highly available to the infant. Bullen and co-workers (11) have shown that lactoferrin works in combination with antibodies to prevent the growth of E. coli. If there is an overabundance of iron, not all iron can be bound, and bacteria can then proliferate.

Food Sources

Prior to 1977, infant cereals were fortified with sodium iron pyrophosphate but when this form was found to be of low bioavailability the manufacturers changed to electrolytically reduced iron of small particle size, which has a relative bioavailability two to four times greater than the pyrophosphate (11). Studies are now required to assess the impact of this change. Regular family cereals are not suitable as they contain only one-seventh the iron added to infant cereals. Parents not wishing to purchase commercially prepared infant cereals should be advised to introduce meats, or diluted prune juice by six months.

TABLE I

IRON CONTENT OF SELECTED CEREALS

(values expressed for 45 mL (3 Tbsp.))

Type of Cereal	Iron (mg)
Infant cereal	2.7 - 3.5
Cooked oatmeal	0.3
Wheat germ	1.4
"Enriched"* cream of wheat	3

* Enriched with iron phosphate. This compound is not as available as the electrolytically reduced iron added to infant cereals.

Vitamin D

Vitamin D is an essential factor in the prevention of rickets*. Experience over several decades has shown that an intake of 400 International Units (10 micrograms) per day will prevent rickets, promote normal growth and maintain normal calcium and phosphorus homeostasis without toxicity (12).

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* Rickets can occur with a deficiency of vitamin D, vitamin D metabolites, calcium, or phosphate.

Commercial infant formula contains 400 International Units (I.U.) per litre, and infants receiving formula do not require additional vitamin D.

The recommendation that breast-fed infants receive a vitamin D supplement is based on repeated analyses of human milk showing an average of only 20 I.U. per litre of fat soluble vitamin D activity (13).

While the amount of vitamin D present in breast milk is less than the minimum 100 I.U. required to prevent rickets, the incidence of rickets in breast-fed infants is rare (12,14). How then are vitamin D requirements of these infants being met? Weisman and co-workers (14) have suggested that vitamin D and its analogues (25-OH D; 24,25$(OH)_2$D), which pass through the placenta during the last trimester of gestation furnish the main vitamin D supply of the newly born infant during the first few months of life. This assumption is supported by observations that vitamin D deficient rickets in infants is associated with mothers whose vitamin D status is poor. Women on pure vegetarian diets (15), women who live in relatively cloudy, cold countries, and receive little exposure to sunlight (16), women with dark skin that resists conversion of the vitamin D precursor by the sun (17), and women consuming a diet low in vitamin D (no vitamin D enriched cow's milk or D supplements) may be particularly suspceptible. It is not known whether these vitamin D stores are present, however, nor if they are present, how long they last. Until more information becomes available, Vitamin D (400 I.U. daily) is recommended for breast-fed infants.

Supplements should be continued until an infant is consuming at least 480 millilitres (16 ounces) of vitamin D enriched, whole cow's milk daily.

Fluoride

Fluoride plays an active role in preventing dental caries. If fluoride is ingested while teeth are still developing, it is incorporated into the enamel to form fluorapatite, which is less soluble in acid than hydroxyapatite (18).

Since dental caries is the major cause of loss of teeth before age 35 (19), fluoride should be regarded as an essential component of the diet. Almost every food contains at least a trace of fluoride but the total intake from solid food is relatively small (20,21). Only seafood (fish, clams, lobster, crabs and shrimp) (22), tea (20,23) and some well water contain significant amounts of naturally occurring fluoride.

The fluoride content of water can be analyzed by the "Water Quality Check Program" of the Ministry of Environment or through the Water Fluoride Analysis Service, Department of Oral Biology, University of British Columbia.

Some communities fluoridate their water. For a list of communities with fluoridated water, see Appendix C.

The average fluoride content of breast milk is well below 0.1 milligrams per litre (20, 24). The level of fluoride in commercial infant formulas varies according to the manufacturing process and water supply used. Information on fluoride content of formulas can be obtained from the Dental Health Division, British Columbia Ministry of Health.

The College of Dental Surgeons of British Columbia have adopted the guidelines established by The American Academy of Pediatrics and The American Dental Association's Council in Dental Therapeutics. These guidelines are outlined in Table II and apply whether the infant is breast-fed or formula-fed. Fluoride supplements should be given as soon as possible after birth to the age of 14 years. This results in a maximum benefit for deciduous dentition, as well as offering the greatest protection for permanent teeth.

TABLE II

SUPPLEMENTAL FLUORIDE DOSAGE

(milligrams fluoride per day) (25)

Age	Fluoride Concentration in Drinking Water (p.p.m.*)		
	0.0 - 0.3	0.3 - 0.7	over 0.7
birth - 2 years	0.25	0	0
2 - 3 years	0.50	0.25	0
3 - 14 years	1.00	0.50	0

*p.p.m. = parts per million (milligrams per litre)

Infants living in fluoridated zones will receive fluoride from commercial infant formulas, evaporated milk formula, solid food and tap water and should not be supplemented. There is a risk of enamel fluorosis if supplements are given as well (22,26). Excessive supplementation during calcification can also cause enamel fluorosis over time.

In areas where the water supply is deficient in fluoride, dietary fluoride supplements must be given accurately and on a regular daily basis (25). Inadequate supplementation restricts the potential preventive benefits.

Fluoride supplements sold as vitamin-fluoride combinations are not recommended because it is difficult to correlate the vitamin requirements with the necessary fluoride requirements. Furthermore, fluoride supplements should be given daily from birth to the age of 14 years, whereas other supplements are not necessary once dietary intake is sufficient. Vitamin-fluoride supplements are also contraindicated because the vitamins plus the food sources of vitamins often exceed the recommended intake (Appendix B).

Fluoride drops are particularly convenient for use with infants because they can be dispensed directly into a child's mouth. Fluoride tablets or lozenges are most commonly prescribed for children whose primary teeth have erupted and who are beyond danger of choking on hard items. Erupted teeth can derive a significant topical benefit from fluoride supplements if the supplement remains in contact with the teeth for a period of time before it is swallowed. Tablets and lozenges should therefore be chewed and the resulting salivary fluoride solution swished around the teeth before swallowing (22,27).

Appendix A

RECOMMENDED DAILY NUTRIENT INTAKES - INFANTS (12)

(amount per day)

Age in Months	0-2	3-5	6-8	9-11
Energy (kcal/kg body weight)	120-100	100-95	95-97	97-99
Protein (g)	11	14	16	18
Fat-Soluble Vitamins:				
Vitamin A (RE)	400	400	400	400
Vitamin D (ug)(I.U.)	10(400)	10(400)	10(400)	10(400)
Vitamin E (mg)	3	3	3	3
Water-Soluble Vitamins:				
Vitamin C (mg)	20	20	20	20
Thiamin (mg/1000 kcal)	.40	.40	.40	.40
Niacin (NE/1000 kcal)	7.2	7.2	7.2	7.2
Riboflavin (mg/1000 kcal)	0.50	0.50	0.50	0.50
Vitamin B_6 (mg/g protein)	0.015	0.015	0.015	0.015
Folacin (ug)	50	50	50	55
Vitamin B_{12} (mg)	0.3	0.3	0.3	0.3
Pantothenic Acid (mg)	2	2	2	2
Minerals:				
Calcium (mg)	350	350	400	400
Copper (ug/kg body weight)	80	80	80	80
Magnesium (mg)	30	40	45	50
Iodine (mg)	25	35	40	45
Iron (mg)	0.4	5	7	7
Zinc (mg)	2	3	3	3

Appendix B

Commercial Preparations of Vitamin and Mineral Supplements

Vitamin D is required by breast-fed infants. The one vitamin D supplement available in British Columbia is a very concentrated product and could result in an overdose because the dropper is not calibrated. Vitamin D has been shown to retard linear growth at levels of 1800 I.U. per day (28). The best compromise at the present time is Tri-Vi-Sol. It meets the vitamin D requirements and its content of vitamin A and C would lead to the least excessive intake.

Fluoride should be given separately. Fluoride administration must continue until a child is 14 years, whereas other supplements (i.e. vitamin D) are not necessary once dietary intake is adequate.

SELECTED VITAMIN AND MINERAL SUPPLEMENTS (29)

PRODUCT	COMPANY	DAILY DOSE		NUTRIENT CONTENT		
			A(IU)	D(IU)	C(mg)	Other
Vitamin D						
Drisdol	Winthrop	2 drops		500		
Vitamins A & D						
Cod Liver Oil	Jamieson	1 capsule	1250	100		
		1 mL	1000	100		
Vitamins A,D & C						
Tri-Vi-Sol Drops	Mead	.6 mL	1500	400	30	
	Johnson	1 tablet	4000	400	75	
Multiple Vitamins						
Infantol Drops	Horner	.5 mL	3000	400	40	Thiamin Riboflavin Niacin, B_6
Infantol Liquid	Horner	5 mL	1500	400	80	Thiamin Riboflavin Niacin, B_6
Poly-Vi-Sol Drops	Mead Johnson	.6 mL	1500	400	30	Thiamin Riboflavin Niacin
Poly-Vi-Sol Tablets	Mead Johnson	1 tablet	4000	400	75	Thiamin Riboflavin Niacin
Pardec Liquid	P.D.	5 mL	5000	400	50	B12, Thiamin Riboflavin Niacin, B_6 Pantothenic Acid

PRODUCT	COMPANY	DAILY DOSE	NUTRIENT CONTENT Iron (mg Elemental Iron)
Iron			
Fer-In-Sol Drops	Mead Johnson	.3 mL	7.5
Fer-In-Sol Syrup	Mead Johnson	1.25 mL (1/4 tsp)	7.5
Fluoride			Fluoride (mg Fluoride ion)
Pedi-Dent Drops	Stanley	2 drops	.25
Pedi-Dent Chewable Fluoride Tablets	Stanley	1/4 tablet	.25
Fluor-A-Day	Pharma-science	1/4 tablet	.25

PRODUCT	COMPANY	DAILY DOSE	NUTRIENT CONTENT				
Vitamins with Iron			A(IU)	D(IU)	C(mg)	Iron (mg)	Other
Tri-Vi-Sol with Iron	Mead Johnson	1 tablet	4000	400	75	12	
Poly-Vi-Sol with Iron	Mead Johnson	1 tablet	4000	400	75	12	Thiamin Riboflavin Niacin
Pardec, Chocolate Chewable	P.D.	1 tablet	5000	400	75	7	Thiamin Riboflavin Niacin Pyridoxine B_{12}
Vitamins with Fluoride			A(IU)	D(IU)	C(mg)	F(mg)	Other
Tri-Vi-Sol with Fluoride	Mead Johnson	.6 ml	1500	400	30	.25	
Tri-Vi-Flor Drops	Mead Johnson	.6 ml	1500	400	30	.5	
Poly-Vi-Flor	Mead Johnson	.6 ml	4000	400	75	.5	Thiamine Riboflavin Niacin
Fluorac	USV	1 tablet	5000	400	75	.5	Pyridoxine

Appendix C

BRITISH COLUMBIA COMMUNITIES
WITH
FLUORIDATED WATER SUPPLIES
AS OF JANUARY 1984

Community

- Aldergrove, C.F. Station
- Baldy Hughes, C.F. Station
- Burns Lake
- Campbell River
- Chilliwack, C.F. Base
- Comox
- Courtenay
- Cranbrook
- Fort St. John
- Golden
- Gold River
- Holberg, C.F. Station
- Kamloops
- Kelowna
- Kitimat
- Lake Cowichan
- Mackenzie
- Port Hardy
- Prince George (including South Fort George)
- Prince Rupert
- Smithers
- Sparwood
- Squamish
- Terrace
- Williams Lake

C.F. = Canadian Forces

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CHAPTER V

COMMON PROBLEMS WHICH MAY AFFECT AN INFANT'S NUTRITION

GUIDELINES AND SUMMARY

Fever, vomiting, diarrhea, constipation, teething and colic are problems which may disrupt a baby's feeding. Infants who are overweight or who are not gaining enough also require nutritional intervention. Nutritional guidelines as they apply to these problems are discussed. In all cases, health professionals should advise parents to contact their physician.

-###-

NUTRITIONAL CONSIDERATIONS OF FEVER

Liquids are more important than food during the first day or two of a fever. Continue milk feedings and offer water or juice frequently to prevent dehydration. A medicine dropper can be used to place liquid directly into a baby's mouth. Force feeding is not necessary. If fluids only have been fed for a day or two, then plain foods such as applesauce or mashed banana should be offered to initiate re-feeding.

NUTRITIONAL CONSIDERATIONS OF VOMITING

Spitting up after a meal is common. Food a baby has recently swallowed simply comes up into the mouth and spills out. Frequent causes are: inadequate burping, too much activity after a meal or over-feeding.

Persistent or projectile vomiting should be discussed with a physician. When vomiting occurs as the result of an illness, only water, not food, should be offered (in addition to any other necessary treatment). A few hours after vomiting ceases dilute fruit juice, breast milk or formula may be given. If this stays down, cereal feedings can be resumed.

NUTRITIONAL CONSIDERATIONS OF DIARRHEA

Diarrhea is defined as "the passage of frequent, unformed or watery stools" (1).

Normality and number of daily bowel movements varies with each infant. The infant's age, and the nature of the diet also determine bowel movement characteristics. Breast-fed babies can, and often do, produce only a small stain on the diaper or small, runny, frequent stools, which may vary considerably in colour and consistency from day to day. Diarrhea is rare in breast-fed infants. Formula-fed infants have firmer stools.

Diarrhea of a food related origin may result from gastrointestinal allergy, infection (2,3), too much fibre, vitamin supplements (excess fluorides may cause gastroenteritis (4)), formula underdilution leading to hypernatremia, or feeding a formula that contains too much sugar.

Breast-feeding is encouraged as often as possible during the acute phase of the illness (5). The anti-infective properties may aid the infant's recovery.

Temporary lactase deficiency is a well-recognized feature of acute diarrhea. Formula-fed infants with moderate to severe diarrhea should avoid lactose-containing milk or formulas and then resume these feedings cautiously (6).

Rehydration

Infants with diarrhea require rehydration with water and electrolytes (3). The volume to be administered should be recommended by a physician.

The following standard for rehydration fluids has been suggested by the World Health Organization (W.H.O.). Rationale for this standard is presented in a paper by Hirschhorn (7).

Ideal Rehydration Fluid

Sodium:	75 to 100 mEq/litre
Potassium:	20 to 30 mEq/litre
Bicarbonate (with chloride as the anion):	20 to 30 mEq/litre
Glucose:	75 to 100 mMoles/litre
Osmolarity:	265 to 360 mOsm/litre

Many glucose-electrolyte solutions have been proposed. The following oral rehydrating solution falls within the ranges defined above, but must be meticulously prepared by a pharmacist for accuracy and sanitation.

World Health Organization Oral Rehydrating Solution (3)

	grams/litre water
Sodium Chloride (table salt)	3.5
Sodium Bicarbonate (baking soda)	2.5
Potassium Chloride	1.5
Glucose	20.0

Table I compares the W.H.O. solution with commonly used rehydration fluids.

TABLE 1

SUGAR AND ELECTROLYTE COMPOSITION OF LIQUIDS USED IN ORAL REHYDRATION (8)

	Sugar+			Electrolytes+			Osmolarity++
	Glucose	Sucrose	Other	Sodium++	Potassium++	Bicarbonate+++	
	g/100 mL	g/100 mL	g/100 mL	mM/1	mM/1	mM/1	mM/1
WHO							
Oral Rehydration Solution	2.0			90	20	30	330
Commercial sugar-electrolyte solutions							
Pedialyte	5.0			30	20	28	390
Lytren	1.6		6.4*	30	25	36	290
Gatorade (premixed)	2.6		2.0**	20	3	3	330
Commercial clear liquids							
Jello				22 - 27	1.3 - 2.0		570-640
Carbonated boverages							
Cola	4.8-5.3	0.5	5.1-5.5**	1.7	0.1	13	390-750
Ginger ale	3.3		2.0**	2.7	0.1 - 1.5	4	520-560
7-up	3.3		4.1**	5.0 - 5.5	1.0 - 2.0	0	520-550
Koolaid (sugarless)				0.5 - 1.2	0.1 - 1.3		250-590
Popsicles				4.7 - 5.6	0.5 - 2.0		670-720
Fruit juices							
Apple (liquid)	3.2	1.3	7.5**	0.1 - 3.5	24 - 32		650-730
Grape (concentrated)	6.8	0.5	8.3**	0.8 - 2.8	31 - 44	32	1170-1190
Orange (concentrated)	4.0	0.5	4.6**	0.1 - 2.5	46 - 65	50	540-710
Other clear liquids							
Beef bouillon (cubes)				110 - 170	5.5 - 11		300-390
Chicken broth (canned)				170 - 250	2.2 - 8.2		380-500
Tea				0	5		

+ Concentration may vary due to shelf life, storage conditions and local water supply

++ Range of concentrations

+++ Actual or potential bicarbonate, such as acetate, lactate, citrate

* Corn syrup

** Fructose

Hydration is then maintained by ad libitum breast-feeding; by administering one part plain water for two parts W.H.O. oral rehydrating solution; or by juices, preferably those containing potassium (6). If plain water is used, potassium-containing foods (mashed banana) should be offered when re-feeding is initiated.

Re-Feeding

Fasting is especially harmful in an illness such as diarrhea (3,7). Food should not be given until the child is able to eat, but this period should not last more than six to 24 hours (3). Small frequent feedings are recommended because this increases intestinal digestive enzymes and cell proliferation (7). The response is dose-related, and the inductions are specific (sucrose is a better inducer of sucrase than glucose, for example). Fasting for as little as three days, impairs the absorption of glucose, salt, water, amino acids and the activity of disaccharidases in humans. In children with borderline nutritional status, fasting may be particularly detrimental.

Rice cereal mixed with water, bananas, potatoes and other non-lactose carbohydrate-rich foods can be offered during this period after the initial few hours of rehydration with oral electrolyte solution. Age-appropriate food should be provided as soon as it can be accepted by the child (6).

NUTRITIONAL CONSIDERATIONS OF CONSTIPATION

It is the quality, rather than the quantity of stool that determines constipation. Some infants have one or more bowel movements daily, while others may pass only one stool every two or three days. Both are normal. An infant is constipated when the stool is hard and difficult to pass. Feeding whole cow's milk before nine months is a frequent cause of constipation.

Dietary suggestions for constipation include:

- switching from rice pablum to barley, oat, or soy cereal.
- increasing the fluid intake.
- offering a natural laxative juice such as 15 mL of apple juice mixed in 45 mL of water or for a greater laxative effect, 15 mL of prune juice mixed in 45 mL of water.
- offering the following mixture, which is suitable for older infants (9):

Ingredients:	1 part prunes 1 part dates 1 part figs
Method:	Blend. Feed 15-45 mL per day.

NUTRITIONAL CONSIDERATIONS OF TEETHING

Teething is accompanied by irritability, loss of appetite and wakefulness. Relief measures are:

- providing something cold to gnaw on (a chilled teething ring or a cold or frozen damp washcloth

- providing finger foods for the older infant (dry toast, frozen banana or homemade fruit juice popsicles are also helpful, but the popsicle should be held by the parent to prevent possible injury from the stick.)

  CAUTION: Celery stalks and carrots should never be used. They may cause a baby to choke.

NUTRITIONAL CONSIDERATIONS OF COLIC

An infant who's gaining weight at the expected rate but cries for periods of 1 1/2 to four hours a day, at least six days of the week may have colic. Crying spells usually occur in the evening, and while most babies draw their legs up to their abdomens while screaming, some extend their legs. Passage of gas, from both ends, is common (10). Colic may begin as early as two weeks of age and often mysteriously stops by the fourth month.

The proposed causes of colic range from parental anxiety to food allergy. It is possible that a colicky baby is hungry and needs more milk. The medical literature suggests that colic is equally common amongst the breast-fed and formula-fed.

Holding does not help; rocking, walking, gentle wind-up swings, and automobiles rides sometimes do. Mild heat from a heating pad or hot water bottle may provide some relief. (Caution: Heating pads or hot water bottles should be wrapped in a bath towel to insulate them and prevent the baby from getting burned).

Parents may try changing formula brands, with or without their physician's blessing, or switching from concentrate to ready-to-feed. This should be done with caution as change may further aggravate the situation. Lothe et al. (11) compared the effects of cow's milk protein formula, soy protein formula and protein hydrolysate formula in the management of colic. They found symptoms to be unrelated to diet in 29 per cent of the infants; 18 per cent were symptom-free while receiving soy formula; and 53 per cent were unchanged or colic was worse while receiving soy or cow's milk protein formula, but the symptoms resolved when casein hydrolysate was given.

Some parents claim that early introduction of solids works wonders. While this will put a strain on an immature digestive system, it is hard to resist a frustrated mother's plea to add solids in hopes of improving her child's fussiness.

A recent trend has been the recommendation that cow's milk be eliminated from the diet of mothers whose breast-fed infants suffer from colic. This is largely due to the work of two Swedes, Jakobsson and Lindberg (12) who reported a trial which showed considerable remission of infantile colic in breast-fed babies when the mothers eliminated cow's milk from their diet. Thirteen of the 19 infants studied improved. The Swedes concluded that cow's milk protein may be a cause of colic in some infants. However, Evans and co-workers (13) have criticized this research because the study was not double-blind. In their own double-blind, placebo-controlled, crossover study involving 20 mothers, it was found that avoiding cow's milk by the mother produced no beneficial effect on the incidence of colic in the baby.

Jakobsson and Lindberg (14) have conducted a second study in which they increased the number of mothers and babies to 66 of each and used a randomized, double-blind, crossover design. They concluded that in one third of the breast-fed infants studied, colic may be related to cow's milk consumption by the mother.

Any recommendations regarding the efficacy of removing cow's milk from the mother's diet are tentative, and conclusions cannot be drawn at this time. Milk contributes valuable nutrients to the mother's diet, and two points must be considered if this approach is suggested by the physician. First, if relief from colic does not occur, milk should be re-introduced. Second, the protein, calcium, vitamin D and fluid requirements of the mother must be met through alternate food choices.

NUTRITIONAL CONSIDERATIONS OF THE OVERWEIGHT INFANT

The growth pattern of an infant is determined by comparing the growth curves of that child with the mean growth pattern of others who are the same age or height. An infant who weighs in excess of the 95th percentile for both height and age is either obese or at risk of becoming obese. A healthy infant who is in proportion for both weight and height is not obese.

Concern regarding obesity arises not only because of the related health risks, but because of the increased chance that a fat baby will remain fat. Overweight infants are approximately two and one half times more likely to be overweight as adults than their normal weight counterparts (15). The logical approach to obesity is one of prevention, even as early as infancy. The following points should be considered for the prevention of obesity.

- Parents need to know the amounts of milk an infant may be expected to consume (see page 68); an empty bottle should not be the goal at every feeding. The baby should be recognized as the best educator and parents should be encouraged to respond to their baby's own need.

- Babies cry because they are lonely, tired, thirsty, or have wet diapers. If food is offered whenever a baby cries, the baby becomes overfed and also learns to substitute food for more appropriate solutions when problems arise.

- Certain notions must be dispelled: excessive weight gain should not be interpreted as an indication that the infant is thriving; how readily a baby accepts solid foods or empties a complete bottle is not a measure of parents' competence as child rearers.

- The practice of feeding skim milk or two percent milk to prevent or control obesity is discouraged (see pages 47 to 53).

- The passive baby who sleeps for long periods is considered to be the ideal infant, but even very young babies need to be active. Some infants may need active encouragement and stimulation. Playful time shared by parents and baby can be an active exercising time.

  "Moving and Growing - Exercises and Activities for the First Two Years" (1983) is an illustrated book for parents. It describes safe, enjoyable exercises and motor development activities that can be performed with even the very youngest. Building instructions for simple toys are also included.

Available from:	Canadian Institute of Child Health Suite 202 17 York Street Ottawa, Ontario KIN 5S7 (613) 238-8425
Cost:	Each booklet $2.50; if more than 10 ordered, $2.00 each.

NUTRITIONAL CONSIDERATIONS OF FAILURE TO GAIN

Failure to gain refers to an infant who fails to grow at a normal rate. Appropriate growth for the normal infant requires regaining the birth weight at least by the third week; and doubling the birth weight by four to six months. A more specific definition of appropriate weight gain would be 20 to 30 grams per day during the first three months. An infant who is gaining less than 30 to 45 grams per week during this time is not gaining enough and requires medical evaluation.

There are several causes of poor weight gain in the breast-fed and formula-fed infant with nutritional implications.

The Breast-fed Infant

- Illness. An infant who is ill will not suckle well and will fail to gain as a result. The possibility of illness should always be ruled out first.

- Improper suckling. Observe the baby breast-feeding to determine how the baby suckles and whether the mother is using proper techniques (see pages 14 to 22).

- Quantity of breast milk. Correction of any one or all of the following factors may improve quantity.

Calories. Dieting while breast-feeding frequently compromises the milk supply.

Fluid. Recommended intake is two to 2 1/2 litres per day. Exercise, hot weather, caffeine, alcohol, salty and sweet foods, air-conditioning, rooms set at 21 degrees Celsius all contribute to fluid loss. Colourless urine is one indicator that fluid intake is adequate.

Alcohol. Moderate amounts of alcohol can interfere with oxytocin release and inhibit let-down.

Cigarettes. Smoking can reduce the amount of breast milk produced and may interfere with the let-down reflex.

Poor let-down. Stress, anxiety, and a busy schedule may inhibit let-down. Applying heat to the breasts just before nursing helps. Mothers may also be advised to rest in bed with their baby for one or two days.

The Formula-fed Infant

- Formula over-dilution. Women who do not speak, read or understand English and those who have very little money are particularly at risk. This fact was made very clear two years ago (16) when a formula company changed the scoop size for their powder measure and consequently changed the mixing instructions. Unfortunately, there was no label colour change to make a clear differentiation between cans with new and old instructions. The public health nurses received a call from a mother who could not understand why the baby suddenly was crying a great deal and had to be fed every two hours. Investigation revealed that she was using the new smaller scoop with the amount of water she had always used and thus was over-diluting the formula.

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